



INSTITUTE FOR DEFENSE ANALYSES

## **Assessment of DoD's Central Identification Lab and the Feasibility of Increasing Identification Rates**

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## **PREFACE**

This study was performed by the Institute for Defense Analyses (IDA) in fulfillment of the requirements in the task order entitled *Analytical Assessment of the Efficiency and Effectiveness of the Current USPACOM JPAC Central Identification Laboratory (CIL) Structure* (amended) for the Office of the Secretary of Defense, under sponsorship of the Under Secretary of Defense, Policy (USD(P)). This work will directly support the Assistant Secretary of Defense for Global Security Affairs (ASD(GSA)) and the Deputy Assistant Secretary of Defense of Prisoner of War/Missing Personnel Affairs (DASD POW/MPA) in developing and implementing DoD policy on matters relating to the personnel accounting community.

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## SUMMARY

The Defense Prisoner of War/Missing Personnel Office (DPMO) tasked the Institute for Defense Analyses (IDA) to review the current structure, resources, assets, and physical location of the Central Identification Laboratory (CIL) at the Joint POW/MIA Accounting Command (JPAC). DPMO requested an independent assessment of viable alternatives for enhancing the efficiency and effectiveness of the CIL's operations. Specifically, IDA was tasked to examine the actions needed to increase the number of identifications to 180 per year by 2014.

Responsibility for various parts of the accounting mission is shared among DPMO, U.S. Pacific Command (notably, JPAC), the Service Casualty Offices (SCOs), the Armed Forces DNA Identification Laboratory (AFDIL), and the Life Sciences Equipment Laboratory (LSEL). This study finds that each of these organizations has an important role to play in the accounting mission. It is JPAC, however, and above all its laboratory—the CIL—which spearheads the identification process. Since 2004, the community has averaged 72 completed identifications each year which will serve as the baseline for the remainder of this report.<sup>1</sup> This study considered the role and history of the organizations involved in the accounting mission, documented the current identification process, highlighted concerns with current identification activities, and provided perspectives on the opportunities available to improve processes and otherwise expand the pace of annual identifications.

This report divides its findings and associated recommendations into three main areas. The first group identifies possible improvements in efficiency and effectiveness within existing (or currently planned) resources. The second relates to a pragmatic near-term initiative for expanding CIL identification activities by resolving a targeted set of pending cases already in the CIL accessions. The third addresses the relationship between the long-term priorities of the identification mission and the types and scale of capabilities that would be necessary to achieve the annual identification rate of 180 per year.

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<sup>1</sup> If one considers only identifications associated with Southeast Asia, Korea, and World War II, the annual average is 71.

## **A. PROCESS IMPROVEMENTS**

The study finds there are a number of process improvements that could build upon on-going initiatives within resources available to the accounting community. Nine actions are recommended.

**Recommendation 1: Improve the Communication of Expectations and the Status of Pending Cases.** The CIL could manage the expectations of other members of the accounting community and concerned citizens by better clarifying the nature of the evidence in its possession and the status of the analysis on this evidence. It should clarify such terms as “accessions,” as well as the meaning of “active accessions” and “inactive accessions.” The community would then understand that an “accession” is not equal to one individual, that “inactive” accessions are evidentiary archives that have been found to contain no known American remains, and that accessions are systematically assessed and DNA samples, if they can be taken, are done soon after the remains arrive in the CIL.

**Recommendation 2: Selectively Employ a Broader Range of DNA Methods for Identification.** The CIL incorporates a forensic strategy of material and biological evidence to make identifications. For biological remains, odontological evidence remains a primary line of evidence for the CIL, but it also relies heavily on establishing a match between samples of DNA evidence using mitochondrial DNA (mtDNA). The IDA study team believes this approach is appropriate, but it is necessary to augment such mtDNA assessments in selected cases. Two additional methods (mtDNA with Single Nucleotide Polymorphisms (SNPs) and Y-STR DNA) have the greatest potential use for the CIL cases.

**Recommendation 3: Adopt a Community-Wide Approach for Executing the Proposed “Surge” in Family Reference Sample (FRS) Collection.** The lack of FRSs for all relevant unaccounted-for cases and inefficiencies in the process for collecting such data comprise the single greatest barrier to progress in increasing the current identification rate. The IDA team, therefore, sees strong justification for the initiative (planned for early FY10) to use the Combatant Commander Initiative Fund for accelerating the FRS collection process. Execution of the initiative should incorporate three features:

- JPAC should be designated the Executive Agent for these funds, because the CIL has the greatest visibility and understanding of its FRS requirements and the level of prioritization among them.
- A liaison position between the CIL and the Service Casualty Offices (SCOs) that collect the reference samples from the families would be highly

beneficial, and could help ameliorate some of the challenges that will arise with the BRAC-required moves of AFDIL and the Army SCO.

- Issuing the DoD Instruction on FRS Collection will help clarify roles and responsibilities and should provide a framework for more regularized contacts among the appropriate offices.

**Recommendation 4: Fund R&D on New Identification Methods.** One of the CIL’s three objectives is to “advance research and development in the area of forensic science”; however, because all of its current funding is from the Operations and Maintenance (O&M) account, any such work must be tied to a specific case. A small R&D budget would give CIL scientists greater flexibility to pursue work which could contribute to eventual identifications and would help meet their needs for continuing to conduct scientific research. Many promising new technologies—both DNA and non-DNA—are under way, and additional ideas were identified to the IDA team.

**Recommendation 5: Provide Ample Examination Table Space in the New CIL Facilities.** The expansion of lab space in Building 45 has helped get more cases on the floor at the same time, but the real impact will be felt when the lab space in the newly acquired Building 220 on the Pearl Harbor base becomes available (following the required certification). The latter especially will allow more comprehensive work on co-mingled remains (in particular the Korean War cases) which have not been able to be laid out until now. Adding more table space through the use of rotatable or stacking tables would further promote efficiencies in lab operations.

**Recommendation 6: Create a Human Capital Strategy and Plan for the CIL Scientific Staff.** A comprehensive plan is needed to determine staffing numbers, skills, and experience requirements, to evaluate the sufficiency of current initiatives, and to identify any additional actions needed to ensure JPAC can build a CIL staff that is adequate in numbers, quality, and experience. A JPAC staff survey, conducted in response to this study, provides valuable context for evaluating these issues. While a number of financial incentives have been put in place since 2008, and these may prove useful in attracting new hires to the CIL, additional measures may be needed to retain mid- and senior-level CIL personnel.

**Recommendation 7: Improve Management to Reduce the Stress of Deployment Schedules.** The command is working toward a target of two deployments per year per deploying anthropologist, which would help address concerns of half of the survey respondents that they spend too much time deployed. This would also permit the

anthropologists to spend more time in the lab working on their own cases, peer reviewing others' cases, etc.

**Recommendation 8: Rebalance the Personnel Mix at the CIL to Make More Productive Use of Scientific Talent.** As part of the Human Capital Strategy, several near-term staffing actions could be considered to enhance the efficiency of the CIL's operations, to include: hiring (more) non-deploying anthropologists; reinforcing the use of lab technicians; and allowing current CIL managers to do more case work by hiring a qualified manager to take over some of the administrative-type managerial functions.

**Recommendation 9: Delegate Authority for Preparing Identification Memos.** Currently only the CIL Scientific Director has the authority to prepare an identification memorandum. Given the range of other responsibilities the Scientific Director has, at least one of the CIL's other managers should also be vested with this authority. This will become even more important as identification rates increase.

## **B. NEAR-TERM, TASK-FOCUSED INITIATIVE**

In addition to the recommended improvements in process within existing resources, the IDA study examined two possible increments of added resources for increasing identification rates. The first increment addresses the study finding on the feasibility of a relatively modest near-term initiative focused on resolving identification cases currently pending within the CIL.

**Recommendation 10: Develop and Assess a Plan for a Near-Term Initiative Focused on Pending Korean War Cases.** Several experts identified the potential for resolving approximately half of the current biological remains accessions in the CIL through a five-person addition to CIL staff. The study estimates the costs of such an initiative at approximately \$1–1.2 million annually. This would yield approximately 30 more identifications each year. The alternative of locating the initiative on the mainland versus co-locating it within JPAC was evaluated. Of all the factors considered, two are the most important: (1) the cost of personnel and the ability to attract qualified people and, (2) the trade-off between the advantages of having part of the identification activity located nearer to AFDIL and the SCOs and the disadvantages of having a small staff isolated from its parent organization.

### C. CLARIFICATION OF LONG-TERM PRIORITIES AND MISSION NEEDS

In examining the task order's goal of expanding identification rates to 180 cases per year, the study finds that the kinds and scale of required additional resources is very sensitive to several priority and planning variables.

**Recommendation 11: Create a Long-Term Mission Execution Plan.** A strategic review should be undertaken to clarify accounting mission priorities and to examine the implications for workload and needed capabilities across the accounting community. Among the planning factors to be addressed are:

- Phasing down recovery operations in Southeast Asia
- Resuming recovery operations in North Korea
- “Proactive” versus “reactive” approach to WWII recoveries
- Exhumation of Korean War remains at the Punchbowl (once identification technology(ies) are ready for full-scale use)

Within five-to-ten years—unless access to North Korea is resumed—virtually all of the accounting community's recoveries and identifications will be from World War II.

Finally, in terms of CIL location (for the entire lab) and command relationships, the future mission should be the primary determinant. As long as the policy remains that the CIL should be focused primarily on identification activities from past conflicts, it is appropriate that the CIL remains integrated with JPAC. If the priorities of its mission were to change, command issues and location would merit reexamination.

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## I. INTRODUCTION

The DPMO tasked the Institute for Defense Analyses with reviewing the current structure, resources, assets, and physical location of the CIL at JPAC. Specifically, DPMO stipulated that

[t]he research effort will incorporate an independent analytical assessment to identify viable alternatives for enhancing the efficiency and effectiveness of the CIL's current operations with an aim of increasing the number of identifications to 180 per year by 2014—a 100 percent increase over the five-year average for years 2003–2007. Field recovery operations may not be decreased and the Department of Defense remains committed to the fullest possible accounting for Americans missing as a result of past conflicts.<sup>2</sup>

### A. THE ACCOUNTING MISSION AND RESPONSIBILITIES

The personnel accounting mission is described in the January 2009 *Personnel Accounting Community Strategy*:

The modern personnel accounting mission was shaped largely in response to public concerns raised during and after the Vietnam War. With the passage of time and our successes in accounting for thousands of Americans, many of those concerns have been overcome. Personnel accounting was organized consistent with a temporary operation but has since evolved into an institutional mission that will continue into the foreseeable future. It continues to serve as an engagement tool with countries around the world, and as such, supports the National Security Strategy and the National Defense Strategy. With that in mind, and with agreement among community members that every unaccounted-for individual is equally important...[it is] reinforce[d that the] personnel accounting role...[is] an enduring mission for the Department of Defense.<sup>3</sup>

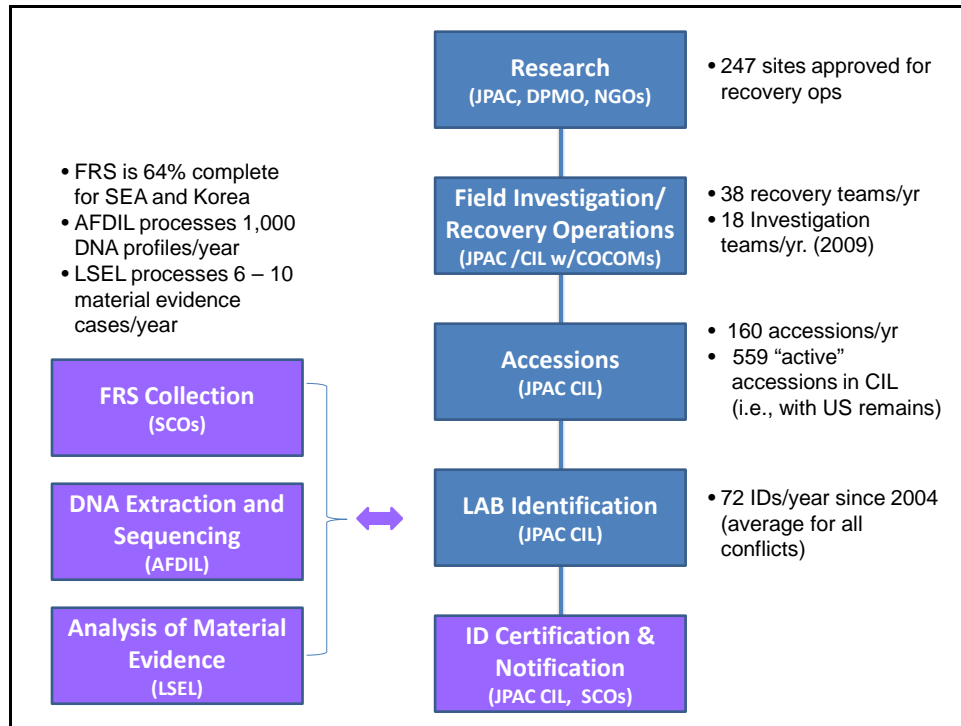
Responsibility for various parts of the accounting mission is shared among DPMO, U.S. Pacific Command (notably, JPAC), the Service Casualty Offices (SCOs), the Armed Forces Identification Laboratory (AFDIL), and the Life Sciences Equipment Laboratory (LSEL). While each of these organizations has an important role to play in the accounting mission, it is JPAC, and above all its laboratory—the CIL—which spearheads the actual identification process (see Figure 1).

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<sup>2</sup> IDA Task Order BB-6-3030.

<sup>3</sup> Foreword to Senior Study Group, *Personnel Accounting Community Strategy*, January 2009, available on the DPMO website, [www.dtic.mil/dpmo](http://www.dtic.mil/dpmo).





**Figure 1. The Accounting Process and Community**

JPAC was activated on 1 October 2003, created from the merger of the US Army Central Identification Laboratory, Hawaii (CIL-HI) and Joint Task Force—Full Accounting (JTF-FA).<sup>4</sup> JPAC, with a current budget of \$51 million, is manned by approximately 400 personnel, of which the CIL scientific staff accounts for 25–30 of the billets.

As noted on the JPAC website, the CIL has three primary objectives:

- To recover and identify U.S. military personnel, certain American civilian personnel, and certain allied personnel unaccounted for from World War II, the Korean War, the Vietnam War, and other conflicts and contingencies.
- To serve as a national forensic resource.
- To advance research and development in the area of forensic science as it relates to the recovery and identification of human remains.

The initial steps in the accounting process include the research to identify potential recovery sites, the investigation of these potential sites to confirm they warrant a

<sup>4</sup> CIL-HI was established in 1976 to search for, recover, and identify missing personnel from all previous conflicts. JTF-FA was created in 1992 for the fullest possible accounting of personnel from the Vietnam War.

recovery operation, followed by one or more recovery operations. These recoveries are led by CIL scientists supported by a military team providing logistics support, communications, and linguists. Recovery operations are complemented by “unilateral turnovers,” provided by local or national governments. Such turnovers occur routinely in Southeast Asia, and some major turnovers have also been provided by the North Korean government. Most notable of these is the “K208,” in which the North Korean government relinquished 208 boxes of remains from various battle sites and mass graves.

When remains are delivered to JPAC’s CIL, they are logged in as “accessions.” Then begins a series of analyses (dental, skeletal, DNA). If the remains are to undergo DNA analyses, a bone sample is cut and sent to AFDIL. JPAC also requests a Family Reference Sample (FRS) of DNA from the appropriate SCO. AFDIL performs the DNA comparison and determines if a match exists. This process—from the time of accession until receiving the input from AFDIL—can last anywhere from three months to 1 ½ years. If there is material evidence to analyze (such as parachutes, uniforms, flight equipment, or aircraft components), this may be sent to LSEL.

An “identification” requires two pieces of evidence which may be biological or material remains. Once a positive identification is made, the CIL prepares the identification package (which is peer reviewed), it is signed off by the CIL Scientific Director, and the report is forwarded to the appropriate SCO, which then presents it to the next of kin.

Table 1 summarizes the identifications completed by the CIL from 2004 (its first full year of operation in the merged JPAC organization) through 2008 for losses from World War II, the Korean War, the Vietnam War, the total for those three conflicts, and the total for all identifications (including those which may be associated with other conflicts such as the Cold War). The average over five years is 71 identifications for the three major conflicts annually and 72 for all conflicts. As shown, the total number of identifications over time has been relatively consistent, while World War II and Vietnam have enjoyed significantly more IDs than the Korean War.

**Table 1. JPAC Identifications by Calendar Year and Conflict**

	WWII	Korea	Vietnam	Total for 3 Conflicts	Total
<b>2004</b>	13	10	28	51	51
<b>2005</b>	47	9	29	85	87
<b>2006</b>	34	20	27	81	82
<b>2007</b>	24	20	18	62	62
<b>2008</b>	27	24	26	77	80
<b>Total</b>	145	83	128	356	362
<b>Average over 5 years</b>	29	17	26	71	72

## **B. STUDY APPROACH**

The identification process is a painstaking one, and there is universal appreciation for maintaining the integrity of the process. The question posed to the IDA study team, nevertheless, is whether the rate of identifications can be increased—without compromising the integrity of the process—and if so, what steps could contribute to such increases.

IDA initiated this study in January 2009. In order to understand and document the current process and potential improvements, the study team interviewed or met with more than seven dozen officials from the DoD organizations involved in the identification process, with external organizations supporting non-DoD identification activities, and with other external experts and concerned citizens. (Interviewees are listed in Appendix A.) The team also visited USPACOM and JPAC, including its CIL, in March 2009. IDA also was able to draw on the results of a JPAC survey of its staff, which provides staff feedback on a number of job satisfaction and workplace issues.

These fact-finding activities helped to clarify the history of the organizations responsible for the identification mission, concerns with the current identification activities, and they provided perspectives on the opportunities available to improve processes or otherwise increase the pace of annual identifications.

## **C. STRUCTURE OF THE REPORT**

The findings and recommendations are organized and reported here in four main chapters, each addressing an element of DPMO's tasking. First, Chapter II focuses on possible improvements in efficiency and effectiveness within existing resource constraints to accelerate the resolution of pending cases. Current practices are described,

and four areas of possible improvement are discussed along with specific recommendations. Chapter III describes some possible management initiatives for expanding CIL identification activities, again largely within currently available resources. Chapter IV examines a short-term initiative aimed at resolving pending Korean War cases in the CIL within the next three to five years, while Chapter V addresses the task order's longer-term goal of increasing the annual rate of identifications to 180. The major conclusion of this work is that some planned changes and minor adjustments could certainly increase the number of identifications, but the actions needed to actually increase the identification rate to 180 are highly sensitive to the future mission, strategy, and priorities of the accounting community—to such a degree that it would be premature to recommend an investment plan, location, and command relationships without first resolving these matters. In short, within five-to-ten years—unless access to North Korea is resumed—virtually all recoveries and identifications will be from World War II. The report concludes with a short Chapter VI that recaps the recommended next steps, if the objective remains to increase the identification rate to 180.

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## **II. RECOMMENDATIONS FOR ACCELERATING THE RESOLUTION OF PENDING CASES**

The first task assigned to the IDA study team was to document existing identification practices and identify potential improvements within existing resource limits. Discussions with CIL staff as well as other parts of JPAC and PACOM indicated that several efforts are already well underway to address some of the long-standing constraints within the JPAC CIL. These include measures to increase lab space and restore full staffing levels. The full impact of these actions on identification rates has yet to be felt.

This chapter addresses four elements of a strategy that builds on the ongoing JPAC initiatives to further improve efficiency and effectiveness across the range of identification activities. Each is discussed along with some specific implementing actions.

### **A. RECOMMENDATION 1: IMPROVE THE COMMUNICATION OF EXPECTATIONS AND THE STATUS OF PENDING CASES**

In the initial effort to document the identification process, the IDA study team uncovered a number of misconceptions and areas of confusion regarding the process and the status of the community's identification efforts. These result from the lack of common understanding regarding the status of accessions and "cases" in JPAC, as well as regarding the feasibility of making identifications with current technology and practices. A focused effort to improve the reporting on these matters would help to reduce this confusion. While this action would not literally increase the rate of identifications, it would increase the understanding of the work that is being accomplished.

Three important areas requiring clarification are discussed here.

#### **1. Clarify the Definition of "Active" and "Inactive" Accessions**

One common misperception encountered in this study is that there is a "backlog" of remains at the CIL which have never been examined or had any analyses conducted on them. This section seeks to clarify the status of accessions currently at the CIL—

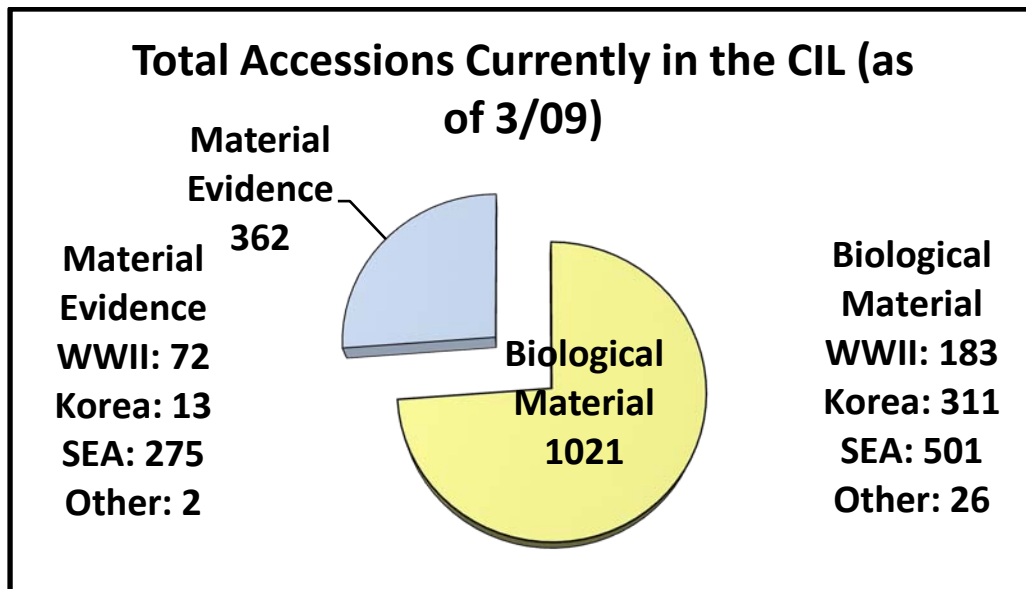
beginning with an explanation of terms being used (see Table 2)—and suggests changes to some of these terms in order to avoid continued confusion and misperceptions.

**Table 2. Definition of Terms**

<b>Term</b>	<b>Definition</b>
Accession	A box (or boxes) of evidence received at JPAC that is either acquired at a site during JPAC field work or is turned over unilaterally. Each accession provides a documented chain of custody relating to an event (field work or turnover) and therefore may not always include evidence or directly correlate with one individual.
Recovery, No Evidence	A new category of accession established in 2006 to indicate that a recovery operation had been conducted but that no remains or other evidence was recovered. In Figure 2 these are included in the biological remains category. (As of 12 March 2009 there were 16 such accessions that had been documented since 2008.)
Active Accession	<p>Either biological or material evidence accessions that:</p> <ul style="list-style-type: none"> <li>• are in the process of being examined;</li> <li>• are awaiting further information (such as DNA sampling results or the collection of an FRS) or new methods/technologies;</li> <li>• are “recovery, no evidence” that have been in the CIL less than 12 months;</li> <li>• are “additional portions”; or</li> <li>• have been identified and are awaiting shipment to the next of kin.</li> </ul> <p>Active material evidence accessions can include those for which no biological remains have been found for an actual identification and there is no expectation of ever being able to find such remains, but the preponderance of evidence points to a known missing serviceman.</p>
Additional Portion	Remains that belong to an individual who has already been identified.
Biological Remains	Evidence that is from the human body, such as bones, fingernails, tissue, etc. that is either recovered during a JPAC operation or handed over unilaterally.
Inactive Accession	An accession which has been analyzed and been determined to have no valid association with any known unaccounted for U.S. serviceman and/or there is nothing else to indicate that the remains are those of an American. This category also includes “recovery, no evidence” accessions that are more than 12 months old.
Material Evidence	Physical evidence, such as dog tags, uniforms, and equipment that is either recovered during a JPAC operation or handed over unilaterally.
MNI (Minimum Number of Individuals)	Estimate done by the CIL when evidence enters the lab about the minimum number of people the accession likely represents.

The CIL categorizes the evidence it receives as “accessions.” An accession is either evidence that is acquired at a site during JPAC field work or evidence that is turned

over unilaterally by an individual or foreign government. There are two basic categories of accessions: biological remains (e.g., bones, tissue) and material evidence (e.g., a dog tag, piece of cloth, helmet). An accession relates to an event (either a field operation or a unilateral turn-over) and the chain of custody of the box obtained. The CIL has very specific, formal procedures for handling and preserving accessions, based on the same standards employed in criminal forensic laboratories.



**Figure 2. Total Accessions Currently in the CIL (as of 12 March 2009)**

Figure 2 shows that as of mid-March 2009, the CIL had a total of 1,383 accessions, of which 1,021 included biological remains while 362 consist of material evidence. An accession can be as small as a single bone fragment or as large as several boxes of remains and material evidence. Since 2006, the CIL has introduced a new category of accessions called “recovery, no evidence” in which case the box does not contain any material.

An important step in clarifying the status of work at the CIL is to differentiate between what are called “active” and “inactive” accessions. This terminology appears to have contributed to misunderstandings about the status of work on-hand in the CIL.

To a layperson, the use of the term “inactive” implies that the CIL has simply set aside these cases either because it is concentrating on other, higher priorities or that it has taken no action on them. In fact, though, “inactive accessions” have been examined and have been found to be cases that have no valid association with any known unaccounted for U.S. serviceman and/or there is nothing else to indicate that the remains are those of



an American. Inactive accessions also include the category of all accessions called “recovery, no evidence” once they have been at the CIL more than 12 months.<sup>5</sup>

Thus, these cases have been analyzed. And while they may represent a dead-end, from the standpoint of yielding additional identifications of unaccounted for U.S. personnel, the JPAC’s evidentiary rules require that they remain archived in the CIL’s store of accessions. The inference that these accessions represent a backlog is, therefore, highly misleading. In order to minimize confusion concerning this category of remains, a different term, such as simply “archived” could make clearer what is contained in these “inactive” accessions, and that they do not constitute a backlog of work.

Each month, accessions that have been in the CIL for at least 12 months are evaluated to determine whether they should remain “active” or be transferred to “inactive” (archived) status. While considerations may vary on a case-by-case basis in accordance with decisions by lab management, as a general rule, the following guidelines are observed in determining whether an accession remains “active” or moves to “inactive” (archived) status:

- Cases generally remain *active* if there is at least one valid name association, fairly good DNA potential from the remains, the site is still open for excavation, and/or there is no way to rule out that the remains do not belong to an American.
- Cases generally are placed on *inactive* (archived) status when there is no probable way to move the case forward due to the absence of any valid name association (or any name at all), the lack of DNA potential, unknown origins or poor background history of where the remains were obtained (in the case of unilateral turnovers), or if the remains have been determined to be non-American. (Accessions that are received through a unilateral turnover can pose additional challenges since often the origins are uncertain and other details that would be obtained when remains or evidence is recovered from a JPAC activity are not known.)

Included in the active accessions are the remains/material evidence of individuals who have been identified, but the remains have not yet been returned to the families. Also included in active accessions are some cases for which no remains have been found and there is no expectation of ever being able to find any remains; the preponderance of

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<sup>5</sup> Sometimes “recovery, no evidence” accessions are moved to inactive status in less than 12 months, depending on lab management availability to make this change.

evidence points to a known missing serviceman, but there are no biological remains for a formal identification.

With this explanation of terminology as background, it is now possible to begin to dissect the meaning of the 1,383 total accessions in the CIL as of mid-March 2009. Of the 1,021 biological remains, there are 559 that fall into the active category. To further break down the 559 active biological remains by conflict, 99 are from World War II, 252 are from the Korean War, and 191 are from SEA. Of 362 material evidence accessions (of which 76% are from SEA), 143 are active accessions.

Table 3 summarizes this information starting from the numbers of total accessions now at the CIL, and how those accessions break down by active and inactive (archived) as well as by biological remains and material evidence. For active biological remains, it further breaks down the numbers by conflict.

**Table 3. Breakdown of Current Accessions in the CIL\***

<b>CATEGORY</b>	<b>TOTAL</b>	<b>BREAKDOWN</b>
<b>Total Accessions</b>	1,383	
With Biological Remains		1,021
Material Evidence		362
<b>Total Biological Remains Accessions</b>	1,021	
Active		559
Inactive (archived)		462
<b>Total Material Evidence Accessions</b>	362	
Active		143
Inactive (archived)		219
<b>Total Active Accessions</b>	702	
Biological Remains		559
Material Evidence		143
<b>Total Active Biological Remains Accessions by Conflict</b>	559	
World War II		99
Korea		252
SEA		191
Other		17

\* Note: These numbers and all others throughout this report are as of 12 March 2009.

Included in the total of 559 active biological accessions, there are 35 accessions with remains identified awaiting presentation to the next of kin. And, as pertains to the POW/MIA mission, 17 active accessions are those not pertaining to World War II, Korea or SEA. It is also possible that at least some of the 16 “recovery, no evidence” accessions that entered the CIL in 2008–2009 have not yet been removed from the active accessions. Finally, in terms of examining the active accessions as the potential for making new identifications, the CIL estimates that 15 active accessions currently at the CIL represent “additional portions” of individuals who have already been identified.

Among the 143 material evidence active accessions, the CIL has estimated that for approximately 50 of these accessions, the evidence has been thoroughly examined and points toward a known missing serviceman and nothing more can be found, but in the absence of remains, an actual identification cannot be made. Thus, these cases should fall into a category that might be called “material evidence for No Further Pursuit (NFP).”

If these considerations are applied, the total active biological accessions that could yield a new identification would be approximately 476, while the active material evidence accessions would amount to about 93. Additional clarification of the status of work on these is explained next.

## **2. Clarify the Status of Pending Active Accessions**

Another misunderstanding about the existing cases in the CIL is that much work on DNA sampling remains to be done. Indeed, prior to receiving clarification on this point, the IDA study team sought non-DoD identification activities to serve as benchmarks in order to determine whether adopting such approaches could yield substantial improvements in the JPAC-CIL identification process. This so-called “DNA-first approach” is used in several humanitarian identification activities such as those in Bosnia, Central America, and South America. These activities rely primarily on DNA evidence for identifying remains, augmented as needed with anthropological and odontological analysis. Based on the benchmark assessment, it is clear that the CIL is already effectively employing a DNA-first approach, in that it samples remains for DNA evidence very early in its process, in a manner parallel to that of the benchmarked activities.

The CIL’s routine process for handling an accession includes an early determination of the feasibility of DNA testing during the initial assessment phase. When

remains arrive at the CIL, it takes about one month for a case file to be generated. The case file is then given to one of the CIL managers who assigns an anthropologist to the case and provides instructions about the extent of DNA analysis to be performed. The anthropologist, in turn, makes the recommendation about the DNA sampling to be done.

Once this initial assessment and DNA sampling is completed, pending accessions may be subdivided into three categories with widely varying timelines for resolution:

- A DNA sample is taken and it is sent to AFDIL for sequencing. This process—from the time of accession until receiving the input from AFDIL—can last anywhere from three months to 1 ½ years. Once matched with reference DNA, the case will move toward resolution.
- A second important category includes those accessions that have yielded DNA, but are still awaiting reference DNA for either identification or exclusion. Such cases will remain in the active accessions until such time as the reference sample DNA is obtained.<sup>6</sup>
- Finally, the third category includes cases for which a CIL determination is made that it is infeasible to test for DNA. In such cases, the remains still are held within the active accessions, pending possible future technology improvements. For example, the new demineralization techniques developed by AFDIL have spurred a comprehensive re-examination of such cases from SEA, in which each accession is being reconsidered for DNA testing using the new extraction methods.

In sum, the IDA study team reviewed the status of pending cases within the CIL with an eye toward improving the lab's use of DNA evidence. This line of inquiry led the IDA study team to conclude that the lab's sampling of DNA evidence essentially employs a "DNA-first" strategy consistent with the best practices employed in comparable activities. (Our subsequent recommendations on the employment of DNA for identifications relate to the collection of reference samples and the selective use of a broader range of relatively new DNA methods.)

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<sup>6</sup> Of the 252 Korean War accessions, the CIL believes that essentially all of them could be identified if the FRS were available. It is also important to note that the K-208 is included in these 252 accessions. Due to the co-mingled nature of the K-208, every remain that could be sampled for DNA has been sampled. With the additional table space in Building 220 (which is expected to become available later in 2009, after an ASCLD-LAB inspection), it will finally be possible for the CIL to lay out these extensively co-mingled remains. The first step will be to group together remains whose DNA sequences match. Then, the anthropologists will examine those remains which could not be sampled for DNA to see what might "fit" with other remains, based on anthropological techniques. The ability to do such methodical work will, in the CIL's estimate, yield about 15 Korean War identifications from the K-208 annually, assuming current personnel capacity.

### **3. Clarify the Distinction between Accessions and Individual Cases**

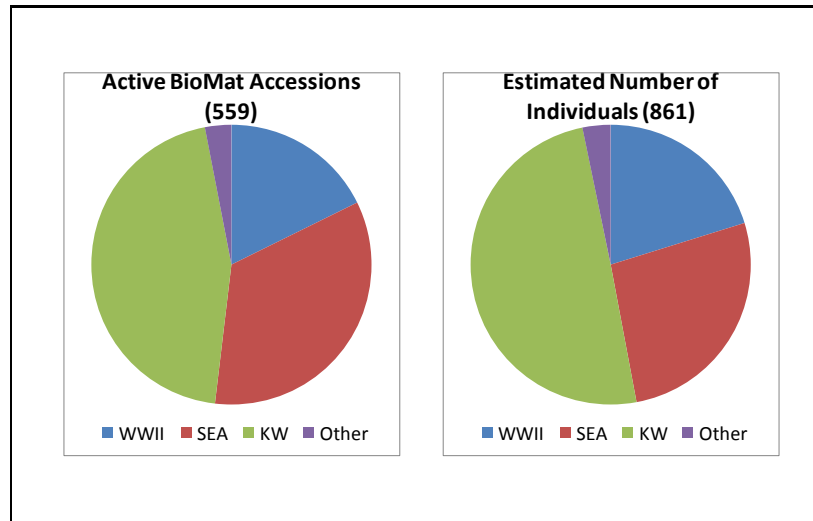
Because accessions are defined in terms of the chain of custody for the evidence yielded by field recovery operations or unilateral turnovers, there is no connection between the number of accessions held in the CIL and the number of individual remains represented in the accessions. When an accession enters the CIL, there is a determination made—effectively, a “best guess”—about how many individuals might be represented in that accession; this is called the MNI or “minimum number of individuals.” It must be cautioned, however, that this is only a guess and, as work continues on a specific accession, this estimate can change substantially. It may be determined that there are several more individuals represented than were originally estimated or it may be determined that an individual in one accession is actually the same individual represented in a different accession.

Until an accession is thoroughly analyzed, it is impossible to categorically state how many individuals it contains. For SEA cases, most recoveries are of one or two seat aircraft. In WWII airplane crashes, the numbers of servicemen on board are documented, so there is a well-defined range. However, in the case of Korean War battlefields or co-mingled unilateral turnovers, the MNI is subject to tremendous variability.

To gauge the order-of-magnitude of the number of individual remains held in the CIL accessions, the current MNI calculations provide the best overall reference point. It is estimated that the remains in the CIL include fewer than 861 American casualties, represented in the 559 biological remains accessions. Figure 3, using MNI calculations, depicts the correlation between total biological active accessions and estimated individuals represented, by conflict. Based on IDA’s calculations of the active biological and material accessions on which the CIL still has work to do (as described earlier in this chapter), it can be roughly calculated that these 476 accessions may represent 767 individuals.<sup>7</sup>

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<sup>7</sup> This calculation is derived by subtracting from 861 the following numbers: 35 individuals already identified, waiting to be sent to next of kin; 28 individuals that are not related to these 3 conflicts (contained in 17 accessions); 16 “recovery, no evidence” from 2008–2009, and 15 accessions that are “additional portions,” based on the assumption that they equate to 15 individuals.



**Figure 3. Active BioMat Accessions and Estimated Number of Individuals, by Conflict.**

In summary, it is important to clarify the status of work at the CIL, and the potential for feasible future identifications, in order to reduce misunderstandings within the accounting community and among interested citizens. The IDA review finds that the CIL has examined the accessions in its holdings and has sampled the DNA whenever feasible, consistent with a best-practice “DNA-first approach.” The ability to resolve pending cases hinges largely on two factors. First, it depends on the availability of Family Reference Sample DNA to resolve cases where DNA has been sampled. Second, it depends on the ability to employ additional, new DNA typing methods for those cases where the customary DNA typing methods do not yield a unique identification. The actions needed in these two areas are interrelated, as discussed in the following sections.

## **B. RECOMMENDATION 2: SELECTIVELY EMPLOY A BROADER RANGE OF DNA METHODS FOR IDENTIFICATION**

### **1. Current Methods**

The CIL incorporates a forensic strategy of material and biological evidence to make identifications. Of the biological evidence, odontological evidence remains a primary line of evidence in CIL cases.<sup>8</sup> Prior to World War II, DoD established that dental characteristics were the primary means of identifying war dead, and as a result,

<sup>8</sup> Thomas Holland, John Byrd, and Vince Sava, “Joint POW/MIA Accounting Command’s Central Identification Laboratory,” in M.W. Warren, H.A. Walsh-Haney, and L. E. Freas (eds.), *The Forensic Anthropology Laboratory* (Boca Raton, FL: CRC Press, 2008), Chapter 4.

there are extensive dental records developed by military dentists of their patients. The CIL exploits this vast information in making its identifications. Independent of the odontological analysis, an anthropologist examines the skeletal remains in a case in order to sort them, since there is likely to be co-mingling of two or more individuals. The anthropologist then develops a biological profile that establishes important information such as age, race, sex, stature, skeletal abnormalities, or trauma that may aid in identification. Forensic DNA typing is also used in the vast majority of the CIL's cases. In the case of excessive co-mingling or where non-DNA evidence is inconclusive, forensic DNA evidence may play an essential role.

There are two types of DNA within human cells that are of interest for forensic investigations, namely mitochondrial and nuclear DNA. There are four DNA-typing approaches available for analyzing ancient remains, of which mitochondrial DNA typing is the predominant method employed in the accounting community today. (See Table 4.)

**Table 4. Assessment of DNA Typing Methods**

Typing Method	Definition	Discriminatory Power	Applicability to Ancient Remains	Reference Sample Requirements	Relative Cost (per analysis)
<b>mtDNA</b>	DNA sequencing of short signature sequences of mtDNA.	Low	Well-established technique. Sampling and analysis successful due to relative abundance of mtDNA over nucDNA	Male or female relative related through the maternal line. Can be several generations removed from missing individual.	High
<b>mtDNA + SNP</b>	As above, plus analysis of single base changes throughout mtDNA sequence.	High	As above. Need basic research to find SNPs to realize power of technique.	Male or female relative related through the maternal line. Can be several generations removed from missing individual.	High
<b>Autosomal STR</b>	Analysis of nucDNA to determine base length of 13 CODIS DNA signatures.	Very High	Technically Difficult-Low abundance of nucDNA that tends to be degraded	Direct relations to missing individual (parents or spouse plus children). Analysis difficulty increases the farther one moves away from direct relations	Lower
<b>Y-STR</b>	Analysis of the Y-chromosome to determine length of known DNA signatures	High	Technically Difficult- Low abundance of nucDNA that tends to be degraded	Male relative related through the paternal line. Can be several generations removed from missing individual.	Lower

### **a. Mitochondrial DNA**

Mitochondrial DNA resides in a structure called the mitochondrion and is separated physically from nuclear DNA (nucDNA) located within the nucleus of the cell. The mtDNA is wholly inherited as a single circular chromosome through the maternal line of one's family tree. Nuclear DNA, on the other hand consists of two copies of 23 chromosomes, one copy from the father and one copy from the mother. Nuclear DNA is inherited differently than mtDNA since each of its chromosomes is independently assorted when passed down to the next generation. In other words, offspring can have many different combinations of parental nucDNA chromosomes depending upon which of the pairs of chromosomes sorts into the sex cells (egg and sperm).

The CIL and AFDIL rely heavily on establishing a match between samples of DNA evidence to either a reference sample of a serviceman's DNA or to that of a close relative.<sup>9</sup> They prefer the use of mtDNA typing for two reasons. First, mtDNA is present in human cells in a much higher copy number than non-mitochondrial DNA in the nucleus of cells. Since there are many more copies mtDNA in each cell, there is a greater chance that enough usable mtDNA exists in the ancient remains with which the CIL must work. Secondly, mtDNA is wholly maternally inherited as a single unit and allows for comparison with more distant maternal relatives. Essentially, any descendant of the mother through the females of the family tree has inherited the same mtDNA as the missing individual and is an ideal donor for an FRS sample.

The process by which mtDNA is analyzed involves sampling mtDNA from skeletal remains, preferably the teeth or the skull since these bones are highly mineralized and protect the DNA from degradation in the environment. The DNA is purified and then many copies of certain regions of the mtDNA are made, using a process called amplification. Polymerase Chain Reaction (PCR) is used for the amplification process. Generally, only very small regions of the mtDNA are amplified out of the total mtDNA, and the molecular structures of these regions is compared to those of the same regions in the reference samples.<sup>10</sup>

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<sup>9</sup> While the reference sample comes most commonly from a family member, recent AFDIL work has demonstrated the ability to obtain DNA from items such as the serviceman's hairbrush, envelope he licked, etc.

<sup>10</sup> These regions are called hypervariable regions 1-3 (HV1, HV2 and HV3). There are 342, 268, and 137 DNA base pairs (bp) out of the 16,569 total bp of mtDNA. HV1-3 represent much of the variable mtDNA sequence among humans and are therefore the most useful for individualization. It is thought



The use of mtDNA for individualization has several drawbacks. First, mtDNA sequences are not highly variable across individuals, so many people will possess the same molecular structure (“haplotype”) within the particular region of DNA examined in the identification process. For example, the most commonly appearing haplotype is seen in the Caucasian population 7.1% of the time.<sup>11</sup> The CIL encounters this issue with its investigation of accessions involving large numbers of co-mingled remains, such as the K-208 accessions. The results of the mtDNA analysis from those accessions yielded many of the more common haplotypes, preventing CIL researchers from both easily sorting the bone fragment remains and knowing exactly how many individual American servicemen are present in those remains.<sup>12</sup>

In addition, population statistics for mtDNA haplotypes are not well known since databases are incomplete.<sup>13</sup> In short, it is not as clear from an mtDNA analysis what is the statistical meaning of a “match.”

#### **b. Expanded Use of Mitochondrial DNA**

To improve discrimination, DNA sequencing of the entire mitochondrial genome, mtGenome, has been studied since 1998 and many newer methodologies have been developed since then. The additional information provided by the entire mitochondrial genome sequence, instead of just using selected regions as described above, can be used to discriminate among individuals possessing the more common DNA types. Studying the sequences of these mtGenomes has established a more rigorous methodology to study mitochondrial population genomics. The results have led to the categorization of genetic differences for broad population groups, and yield somewhat better discrimination of individual identities.<sup>14</sup>

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that this region of the mtDNA varies by 1–2% in the human population, which is ~7–14 bp out of the 610 total bp in the HV region. These bp differences are detected by sequencing the amplified mtDNA.

- 11 Michael D. Coble, Rebecca S. Just, Jennifer E. O’Callaghan, Ilona H. Letmany, Christine T. Peterson, Jodi A. Irwin, and Thomas J. Parsons, “Single Nucleotide Polymorphisms Over the Entire mtDNA Genome that Increase the Power of Forensic Testing in Caucasians,” *International Journal of Legal Medicine*, 118: 137–146, 2004.
- 12 This is why the space in Building 220 is so important to work on the K-208. It will allow the anthropologists to lay out a large portion of the remains at once to help determine which potential matches do, in fact, belong to the same individual.
- 13 Thomas M. Holland and Thomas J. Parsons, “Mitochondrial DNA Sequence Analysis-Validation and Use for Forensic Casework,” *Forensic Science Review*, 11: 21–50, 1999.
- 14 S. Kohnemann, U. Sibbing, H. Pfiefer, and C. Hohoff, “A Rapid mtDNA Assay of 22 SNPs in One Multiplex Reaction Increases the Power of Forensic Testing in European Caucasians,” *International Journal of Legal Medicine*, 122: 517–523, 2008.

### c. Single Nucleotide Polymorphisms (SNPs)

Despite the great strides made in mtGenome sequencing over the last decade, the additional cost of sequencing the entire genome makes everyday use of this method unrealistic. Fortunately, a simpler discrimination method arose out of this DNA sequencing work. In many cases, markers consisting of a single nucleotide DNA base, a SNP, that reside outside the normally sampled regions can be detected and used to resolve common DNA typing issues.

AFDIL and collaborators at the National Institute of Standards and Technology (NIST) have developed a panel of SNPs known as SNaPshot.<sup>15</sup> The discriminatory power of the SNaPshot panel was shown to be high. For example, in one test, AFDIL was able to distinguish 209 of 241 otherwise indistinguishable cases using this method. Based on this test, they were able to develop eight multiplex PCR panels for resolution of these haplotypes. Further, AFDIL has automated the wet lab protocol for performing DNA amplification and detection as well as the data analysis. Using this automated protocol, AFDIL seeks to resolve the problem of sub-par mtDNA databases by sequencing hypervariable regions of ~5,000 samples per year.<sup>16</sup>

Even though SNP assays are less costly than DNA sequencing, they still suffer from a number of drawbacks.<sup>17</sup> SNP assays are based on biochemical or chemical processes<sup>18</sup> which require an analyst to know in advance the SNP that will yield the discrimination being sought. Although AFDIL has demonstrated that these assays are good for automation, the throughput may be non-ideal as well. If one wished to scan the mtGenome for multiple SNPs, the technique can be time-consuming. Protocols have been developed by the FBI and Ibis Biosciences to include electrospray ionization mass spectrometry, which would allow AFDIL to overcome these shortcomings. Mass spectrometry is able to determine small differences in mass between segments of DNA, and since the mass of each DNA base is known precisely, base differences in DNA

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<sup>15</sup> Coble et al., 2004. P.M. Vallone, John P. Jakupciak, and Michael D. Coble, "Forensic Application of the Affymetrics Human Mitochondrial Resequencing Array," *Forensic Science International: Genetics* 1: 196-198, 2007. R.S. Just, Jodi A. Irwin, Jennifer E. O'Calligan et al., "Toward Increased Utility of mtDNA in Forensic Identifications," *Forensic Science International*, 146S: S147–S149, 2004.

<sup>16</sup> Just et al., 2004.

<sup>17</sup> T.A. Hall, Bruce Budowle, Yang Jiang, et al., "Base Composition of Human Mitochondrial DNA Using Electrospray Ionization Mass Spectrometry: A Novel Tool for the Identification and Differentiation of Humans," *Analytical Biochemistry*, 334: 53–69, 2005.

<sup>18</sup> Vallone et al., 2007.

segments can be determined by their mass differences. The mass spectrometry setup has advantages over wet-chemistry detection described above in that sample preparation is minimal and sample through-put is much higher. Ibis Biosciences has a commercial instrument for this purpose (<http://www.ibisbiosciences.com/pages.asp?ID=28>) and AFDIL is scheduled to obtain one of these instruments and presumably increase their throughput in SNP studies.

#### **d. Nuclear DNA (Nuclear STRs and Y-STRs)**

An alternative to mtDNA typing is to use markers on the nuclear DNA for additional information. Nuclear DNA is in widespread use in criminal forensic analyses and it can have both advantages and disadvantages in the casework performed by JPAC and AFDIL. The FBI has developed the panel of 13 Short Tandem Repeat (STR) markers that are used in the United States called CODIS. They have also studied and validated techniques for detecting STRs and have performed population studies in order to understand the prevalence of a particular marker in different human populations. Statistical studies have shown that these markers have extremely high discriminatory power because the 13 different markers are highly variable and the combination of 13 highly variable markers makes the random chance of two matching STR profiles very low. These characteristics make STRs more advantageous to use than mtDNA markers.

Although the benefits of nuclear STRs would seem to make this method ideal for CIL casework, the nature of JPAC/AFDIL's DNA work makes STR studies difficult to perform and will limit their utility to selected cases:

- Nuclear DNA is much larger than mtDNA and therefore more subject to damage after long-term exposure to the elements, which often occurs with remains from past conflicts.
- Nuclear DNA is in lower abundance in cells than mitochondrial DNA making it difficult to detect, especially with degraded samples.
- Unlike mtDNA, autosomal DNA “shuffles” from generation to generation due to the fact that two copies of each chromosome exist in the cell and each of the copies then gets passed down and pairs with a “new” chromosome with each new generation. As one progresses farther away from the missing individual on their family tree, comparing STR profiles from FRS becomes increasingly complicated. Ideally, one would prefer to have FRS from immediate family members such as a mother, father, siblings, or spouse and children. Since the Vietnam conflict ended more than thirty years ago, it is increasingly difficult to complete the FRS necessary to analyze STR profiles. For Korean and WWII cases, it would be even more challenging due to the age of immediate family members.

In order for the CIL to use nuclear STRs on a regular basis, the first two technical challenges would need to be tackled. Also, a new strategy for FRS collection would need to be developed and implemented. Due to the long lengths of time since the ends of these past conflicts, a study needs to be performed to determine if such an FRS collection strategy is feasible. Qualified FRS donors for such a nuclear STR strategy may be rare.

Y-STRs, on the other hand, have utility for JPAC/AFDIL. This method compares the molecular structure of selected regions of the Y sex chromosome, which is inherited as a single copy through the males in a family tree lineage. Therefore, any direct male descendant or ancestor would be ideal to donate a FRS. As with nuclear STRs (also known as autosomal STRs, to distinguish from sex chromosome STRs), Y-STR databases are very well populated, the mutation rates, and the prevalence of Y-STR regions are well-defined. So, a Y-STR match is well understood in terms of population genetics. The FBI Scientific Working Group on DNA Analysis Methods (SWGDAM) has recommended specific regions of Y-STR for forensic studies and commercial kits are now available that detect the SWGDAM Y-STR markers. Additional Y-STR regions are being investigated and validated to increase discrimination among related individuals.<sup>19</sup>

To employ Y-STRs, an alternative FRS collection strategy needs to be developed. However, the advantage of the Y-STR method is that any ancestor or descendant along the male line is a viable FRS donor. Therefore, even male descendants farther away on the family tree can donate FRS, and such donors are more likely to be found.

## **2. Which DNA Typing Method Should be Used?**

Table 5 below summarizes the applicability of the above-described DNA typing methods to the CIL's work. It would seem from the attributes described in the table that the short-term strategy of using mtDNA typing with an accompanying SNP analysis would be most useful for the CIL's work. The methodologies for isolating mtDNA from ancient samples are much simpler than nuclear STR work and discriminatory power improves with the discovery of new SNP markers. However, it is important to make an investment in the improvement of mtDNA databases to understand the statistical meaning

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<sup>19</sup> A.E. Decker, Margaret C. Kline, Peter M. Vallone, and John M. Butler, "The Impact of Additional Y-STR Loci on Resolving Common Haplotypes and Closely Related Individuals," *Forensic Science International: Genetics*, 25: 939–943, 2007.

of an mtDNA match. AFDIL has published reports that indicate this is an important key in their strategy and it should be supported.<sup>20</sup>

**Table 5. Summary of Typing Methods**

<b>Typing Method</b>	<b>Discriminatory Power</b>	<b>Population Statistics of Markers Understood?</b>	<b>Method Amenable to Ancient DNA Samples?</b>	<b>Appropriate FRS Collection Strategy In Place?</b>
mtDNA	Low	No	Yes	Yes
mtDNA + SNP	High	No	Yes	Yes
Autosomal STR	Very High	Yes	No	No
Y-STR	High	Yes	No	No

However, the advantages and discriminatory power of nuclear STRs cannot be ignored. Nuclear DNA STR population databases are quite mature and could be useful to the CIL's work. Unfortunately, the FRS necessary to support work with nuclear STRs is inadequate, the effort to build such a database would be very complex and costly, and the end result would likely be incomplete. It would seem that a Y-STR FRS "surge" would have the best chance for immediate impact since the collection would be far simpler. One would only need to identify appropriate male descendants of a missing individual as opposed to the large combinations that might be necessary with an autosomal STR "surge."

In summary, the use of mtDNA is an appropriate initial approach for assessing the aged remains associated with prior conflicts. There is a need, however, to have the ability to augment such mtDNA assessments in selected cases. The optimal strategy would be driven by the condition of the DNA in the sampled remains, combined with the availability of Family Reference Samples of DNA. Implementing such a strategy requires the close collaboration of the CIL scientists, the scientists performing the DNA extraction and assessments in AFDIL, and the officials responsible for FRS collection in the Service Casualty Offices. The needed community-wide approach for achieving this collaboration is discussed in the following section.

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<sup>20</sup> Just et al., 2004.

### **C. RECOMMENDATION 3: ADOPT A COMMUNITY-WIDE APPROACH FOR EXECUTING THE PROPOSED “SURGE” IN FAMILY REFERENCE SAMPLE COLLECTION**

The lack of Family Reference Samples of DNA for all relevant unaccounted for cases, and inefficiencies in the process for collecting such data, comprise the single greatest barrier to progress in the accounting community. This data is the key to the resolution of many of the pending accessions in the CIL. And it will be needed to address future accessions, as well. For this reason, high priority should be given to the timely completion of the FRS collection, especially for the Korean War and Southeast Asia.

In addition, as discussed in the preceding section, many of the cases involving comingled remains will require the augmentation of the standard mtDNA assessments with one or more of the other approaches. A collaborative collection process will be needed to enable the effective collection of the FRS for these cases.

An FRS “surge” initiative has been under discussion within the accounting community. This initiative would provide funding to accelerate the completion of FRS collection. This funding is vital to resolving existing cases in the CIL and to accelerating the future identification rate. There are, in addition, several management initiatives and process improvements that need to be adopted.

#### **1. The FRS “Surge” Initiative Proposed by the Joint Staff**

In 2008, the Joint Staff obtained inputs from each of the Services about the status of their FRS collections for Southeast Asia, Korea, and World War II, and their resource requirements (funding and personnel) to essentially complete these collections within three years. Based on these inputs, Pacific Command requested (in early 2009) Combatant Commander Initiative Funds (CCIF) in the amount of \$2.9 million from the Joint Staff, which would then be distributed to the Services to accelerate their FRS collection efforts, specifically to complete them for SEA and Korea and to respond to emerging requirements for World War II. These funds were to be used to cover costs of genealogical research (to find eligible family donors), contract support to the SCOs, the purchase of DNA sampling kits, and postage for mailing the kits to family members and returning them to the AFDIL for processing. As currently planned, details on the allocation of this funding among the Services still must be refined. Due to uncertainties about the Services’ abilities to execute spending of these funds before the end of FY09, it is planned to resubmit this CCIF request early in FY10.

Successful execution of the FRS surge will require careful coordination across the accounting community. It will be necessary to create an execution plan which clearly delineates roles and responsibilities for each part of the accounting community (DPMO, JPAC, SCOs, and AFDIL) and which lays out the rules of engagement.

To orchestrate execution, it is strongly recommended that JPAC be assigned as the executive agent for the distribution and employment of the CCIF funds. In addition, to improve communication and understanding, notably between JPAC and the SCOs, two initiatives should be pursued: (1) creation of a liaison position between JPAC/CIL and the SCOs, and (2) creation of a working group for these entities. These concepts are described below. It should be noted that DPMO, with input from other members of the accounting community, has taken important steps already in creating this execution plan in the form of the draft DoD Instruction (F) on DNA FRS Collection. There are some changes and additions that should be made to this document to further strengthen the process.

## **2. Designate JPAC as Executive Agent**

Current plans call for the Services to directly receive this FRS surge funding. This approach is consistent with the philosophy that the Service Casualty Offices should serve as the primary point of contact with Service members and their families. The IDA study team agrees with this principle, and finds the Services' arguments for this approach persuasive. At the same time, future FRS collection efforts would be far more efficient and effective if JPAC were to be designated as the responsible entity for managing the funds.

There are several reasons why JPAC is the most logical entity to perform this function. First, it has the greatest visibility and understanding of its own FRS requirements and the level of prioritization among them. By controlling these resources, JPAC would have the flexibility to adjust priorities as warranted. Second, it has the best grasp of the scientific complexities associated with the collection process, such as the range of suitable donors which may require new collection methods. Third, by retaining control of the resources, JPAC becomes, in effect, a paying customer for the services provided by the SCOs; this ultimately enables JPAC to ensure funds are directed toward collection priorities.

### **3. Issue a DoD Instruction on FRS Collection**

The expanded FRS collection will require additional community-wide guidance and implementing actions. A new DODI on DNA FRS Collection should address issues that have impeded a more effective approach to date. Among other things, a new directive should:

- require that a request for FRS be accompanied by an explanation for the request (either for identification or exclusionary purposes);
- provide guidance on what FRS is to be collected (i.e., for Korean War forward; for World War II and earlier only on case-by-case basis; for No Further Pursuit cases only a case-by-case basis);
- stipulate that JPAC will prioritize (as appropriate, in batches) the new requests for FRS;
- state that JPAC is to provide “complete visibility” to the Centralized Accounting Repository and Information System (CARIS) as pertains to FRS collection to DPMO, the SCOs, and AFDIL; and
- identify the frequency with which some data is to be provided to DPMO from JPAC and the SCOs.

Previous IDA analyses had identified the importance of selecting a suitable existing database as the standard accounting community database for FRS collection and ensuring that it is shared among the members of the accounting community. The broader access to CARIS should promote a more efficient sharing of information, which will be an important step in more effective cooperation. It will be important to ensure, however, that “complete visibility” to CARIS does not translate into organizations other than JPAC being able to input data into all of CARIS’ data fields. Rather, it could be agreed that only specific field(s) of the database would be updated by the responsible organization for that field.

A new DoDI would also be useful for providing some timelines in the exchange of information, such as establishing procedures for following up with a family member who has received a kit but not returned it to AFDIL within 60 days, or that AFDIL will sequence an FRS within three months of receipt. Guidelines also would be useful to promote more timely exchanges of information. Notably, it should indicate for how long a SCO should seek a maternal relative before notifying JPAC that it cannot find one.



Similarly, once so notified, it should note how long JPAC should take to notify the SCO whether to pursue an alternate FRS source.<sup>21</sup>

Finally, the new DoDI should require JPAC to retain on the public side of its website the listing of those for whom an FRS is still being sought. Given that the website also contains appropriate guidance about contacting the SCOs, this information provides a valuable avenue for reaching out to the public about the continued need for FRS.

#### **4. Unify Efforts Across the Accounting Community**

A successful expanded FRS collection effort will require improved communication and understanding, especially between the SCOs and the CIL. There is little doubt about the frustration felt on both sides. The SCOs believe they are not given adequate information about why an FRS is being sought (whether for an identification or for exclusionary purposes) nor do they feel the CIL provides guidance about priorities within the lists the CIL sends them. The SCOs also note that names are sometimes still on a new CIL list, even after the SCO has reported that they were unable to find a maternal donor. For its part, the CIL has been frustrated by inaccurate depictions of family members' relationships to the missing servicemen (which can make the FRS unusable), the unwillingness of the SCOs to share information the genealogists have accumulated prior to stopping work on a case, and decisions to stop pursuit of leads due either to contractual time limits or leads going outside the United States. These difficulties are long-standing, representing more than just "personality-based" disagreements.

For the Joint Staff initiative to work, there needs to be frequent and effective communication between the SCOs and the CIL. One solution would be to use some of the CCIF to designate a liaison, logically co-located with the Army SCO (which bears the brunt of the pending FRS work, especially for the Korean War, and which will be additionally challenged by its BRAC move), but who could interface between all four of the SCOs and the CIL. The sole focus of this liaison's work would be coordinating the inputs and queries on FRS collection over the next two to three years, including ensuring accuracy of the relationship of the donor to the missing person, helping to sort through remaining questions of prioritization, keeping track of deadlines on cases, etc. An additional important tasking would be to reexamine all cases for which mtDNA has not

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<sup>21</sup> In terms of SCO reports to DPMO about the status of requests (see Enclosure 2, paragraph 7c), additional detail should be required in order to note attempts, first, to obtain maternal FRS donations and then also for follow-up contacts for alternate DNA donors, when so determined by JPAC.

been possible or has not yielded results (except for adoption cases) and, following confirmation from the CIL that alternate DNA could be pursued, redirect the SCOs' genealogists to identify potential alternative DNA donors. Given these responsibilities, the person filling the liaison position will need to have a firm grasp of the scientific aspects of this work.

Another way in which to improve SCO-CIL communication is to establish an FRS working group which would convene at least once a year, twice a year if mutually determined to be warranted. JPAC is already pursuing this idea, which logically will contribute to better dialog and understanding. This working group might also discuss whether genealogists should be instructed to prepare a fairly comprehensive family tree, at least for close relations, from the outset or whether they should be instructed to work for a certain number of days strictly on trying to find maternal-eligible donors.

The most important objective of the working group is to offer direct face time to work through outstanding issues on specific cases. In this context, it would be extremely beneficial to collaboratively develop data definitions and categories that all parties would use in characterizing the status of FRS requests and collection.

## **5. Address BRAC-Related Disruptions at AFDIL and the SCOs**

The current round of BRAC poses significant challenges for the accounting community, especially in terms of its DNA-based work, both FRS collections and DNA analysis of remains. The major disruptions will be the Army SCO's move from Alexandria, VA to Ft Knox, KY and AFDIL's move from Rockville, MD to Dover, DE. The former is slated to begin in early 2010 and not be complete until September 2010, while AFDIL—which requires construction of a new building—will not fully move into its new space until September 2011, but already is concerned about being able to make its target of 1,000 specimens to be reported in 2010.<sup>22</sup>

In both cases, there will be notable down-time due to all the normal demands of moving an office over an extended distance. Equally disruptive will be the loss of personnel and the need to train up replacements; this especially will be a challenge for AFDIL with the skill sets that are needed for the DNA work it conducts. Based on

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<sup>22</sup> The Air Force Mortuary Affairs Operation has also been moved, from Texas to Delaware. However, since for the purposes of the accounting effort, the Air Force has more “manageable numbers” and there is just one central person, who has opted to move, the impact of this disruption is less severe. The Life Sciences Equipment Laboratory (LSEL) is also being BRAC'd, from TX to OH in September 2010; it expects to lose about half of its staff.

general corporate experience involving a distant relocation, the retention rate averages 20–30% of the workforce across the board. While unskilled labor, particularly in the current economic climate, would likely not be difficult to replace, the replacement of technical, skilled personnel will be another matter. Preliminary inquiries reveal that younger staff at AFDIL is more willing to relocate, while more senior staff (especially those who are well settled and have spouses employed in the National Capital Region) are less likely to move; AFDIL hopes that it will be able to retain about 50% of its personnel. In the case of the 14 civilians at the Army's Past Conflict Repatriations Branch, less than 50% of those indicated a preliminary intention to relocate, and it is expected that only one senior civilian will actually move.

Under current plans, there is no possibility that either of these offices will be able to keep to their current levels of effort for the accounting mission during this transition time. Optimistic estimates are to expect about a 50% reduction in capacity over a six-month period. Other estimates project an even longer time at significantly reduced capacity. During this time, one temporary way to ease AFDIL's workload would be to have a similarly accredited facility (ASCLD-LAB certified) process the FRS samples. The results of this processing could then be sent to AFDIL for its future work in comparing FRS with the sequences from remains. Due to the sensitivities and complexities of the work, there is justification for the strongly held view that the sequencing of remains should not be contracted outside AFDIL. For the operations of the Army SCO, if the recommended liaison position were established in the Army SCO, a graduated move might be able to reduce some of the negative impact of lost personnel.

In sum, it is necessary for the accounting community to create an alternate plan to ensure continuity of operations and thereby minimize the extent of disruptions on FRS collection and DNA sequencing and processing.

## **6. Assessed Implications for Identifications**

When the CIL requires an FRS either to identify remains in the lab or to prepare for future recoveries, the DNA coordinator submits the request to the appropriate SCO. The success with which the SCOs are able to track down the appropriate family members varies greatly, constrained mostly by lack of manpower especially in light of competing priorities. They may also provide additional (unrequested) FRSs from family members who have approached the SCOs or "walk-ins" at monthly family member updates. The following data provides an illustrative example:

- In 2006 the Army SCO provided 589 FRSs to the CIL (393 of them had been requested);
- In 2007 the Army SCO provided 686 FRSs to the CIL (461 of them had been requested); and
- In 2008 the Army SCO provided 359 FRSs to the CIL (188 of them had been requested).

However, it should be noted that the requested FRSs may have been requested several years prior to their delivery to the CIL, making it impossible to track the time lag at this time. Thus it is impossible to fairly estimate the current rate of FRS collection and what can reasonably be expected to be collected during the FRS surge, though most interviewees agreed that the proposed FRS surge strategy will help tremendously.

An accelerated FRS initiative will unquestionably increase identification rates both for remains currently at the CIL and for remains still to be recovered from the field. If all FRS were available for all remaining SEA and Korea War cases, the CIL estimates that they would then be able to identify every set of Korea War remains currently in the CIL. These remains represent 252 accessions, or approximately 428 individuals.<sup>23</sup> Assuming the planned timeline of a 3-year intensive push to collect the stipulated FRS, there should be a commensurate target for the CIL to complete those active accessions currently in its possession within the next three to five years.<sup>24</sup> In terms of individual identifications, the CIL estimates that the more robust FRS collection, together with the extra table space offered by Building 220, could yield approximately 30 Korean War identifications alone annually, with current staffing levels. (Chapter III proposes an initiative to target the resolution of Korean War accessions in 3 to 5 years.)

In the case of SEA remains currently in the CIL, a thorough scrub of each accession would need to be made in order to determine the potential impact of having all FRS in hand. During discussions at JPAC in March 2009, there were general estimates offered that as many as 50 accessions, or approximately 50 individuals, would be resolvable if all FRS were available.

For WWII cases in the CIL, it must first be noted that these cases are not routinely sampled for DNA. Because it is impractical to conduct a blanket FRS collection effort for all 80,000 WWII missing, the CIL will employ DNA sampling only in cases where

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<sup>23</sup> This includes the K-208. See section on “Clarifying Accessions” for information about the difference between accessions and individuals and the estimated number of individuals.

<sup>24</sup> The Joint Staff J1 Family Reference Sample Collection Surge strategy lays out the detailed requirements for the FRS Collection Surge over the course of three years.

JPAC's J2 analysts provide a testable hypothesis about who the remains might represent. Thus, J2 and the CIL would need to work together to scrub all the existing WWII accessions (as of mid-March, 99 accessions) in the lab to reasonably estimate how many should be sampled for DNA (assuming an FRS could be obtained). But given historical success in obtaining DNA from WWII remains, it is reasonable to assume that a majority could be successful.

In summary, there remains substantial untapped potential to employ DNA typing in the identification process. But to do so will require additional funding for FRS collection and much more effective collaboration across the accounting community in targeting and collecting references samples. This area represents a difficult organizational challenge, but one where the return on the effort will be substantial.

#### **D. RECOMMENDATION 4: FUND R&D ON NEW IDENTIFICATION METHODS**

Although the CIL is supportive of internal R&D—indeed, “advancing research and development in the area of forensic science” is one of its three primary objectives—and some does take place on a case-by-case basis (particularly when a given case demands the application of a new technique), the absence of a designated R&D budget has limited opportunities to pursue research ideas. In the JPAC survey provided for use in this study, nine CIL staff indicated they had a range of research ideas which could likely contribute to more identifications. (Survey results are summarized in Appendix C.)

R&D could help to increase the rate of identifications in two ways. First, opportunities to pursue research could attract mid and senior anthropologists to the CIL. Being academics, anthropologists will typically want to make contributions to the field of science through their own research and papers. However, lab staffing and work assignments would need to be rebalanced to accommodate these research activities. Long and frequent deployments, case work demands, and the need to link any R&D work to an existing case (because the CIL's funding is O&M money) have sometimes limited CIL anthropologists' opportunities to perform such research. Second, R&D projects that have been undertaken have made valuable contributions to science and to the laboratory's applied work.

Several of the potential lines of research identified in the course of the review are described in the remainder of this section. None of these require large-scale funding. The Scientific Director of the CIL indicated that an annual research budget of \$500,000 would

be sufficient to make progress and would be consistent with time available to pursue research tasks.

## **1. New Non-DNA Technologies**

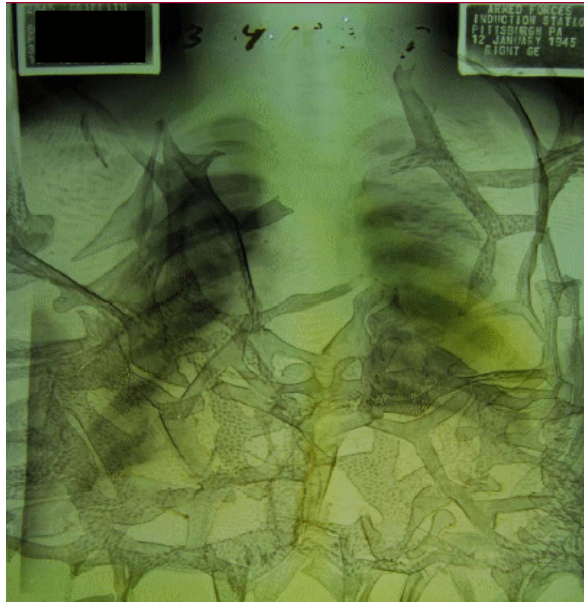
The CIL is developing promising strategies that do not involve DNA to identify remains that are not conducive to DNA testing. They include:

- Comparison of X-ray bone fragments with chest X-rays of warfighters
- Facial reconstruction by photo superimposition
- Comparison of dental records of warfighters with remains
- Comparison of eyewear lens prescription with eyewear artifacts

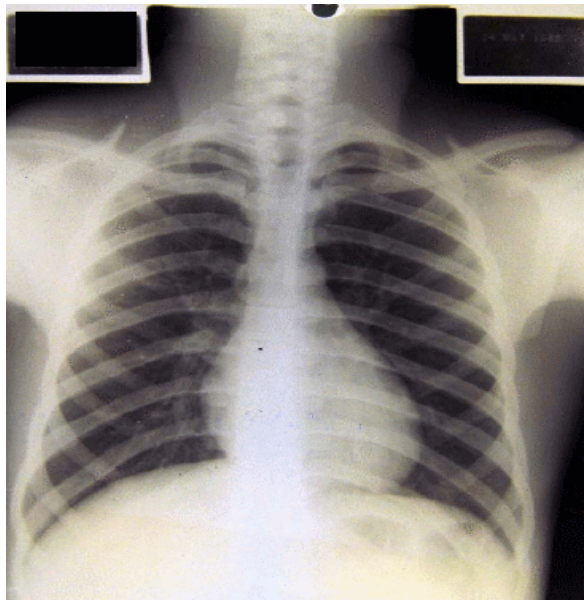
Each of these is described in the following sub-sections.

### **a. Comparison of X-Rays of Bone Fragments with Chest X-Rays of Warfighters**

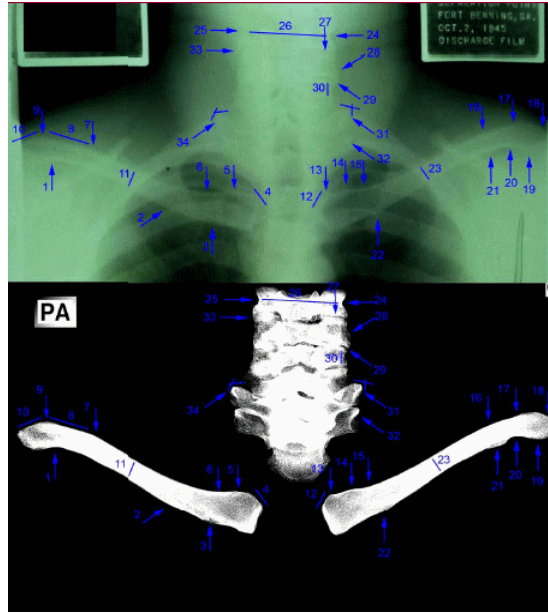
CIL researchers found that the National Personnel Records Center (NPRC) contains ~6,600 X-ray autoradiographs of servicemen taken before their deployment. These X-rays are more than 50 years old; some have degraded while others are in a good enough condition to be interpretable. Since it was known to whom these X-rays belonged, it was postulated that a comparison of bones to the NPRC X-rays might lead to information to help identify missing servicemen. X-rays of bones such as clavicles and vertebrae from Punchbowl remains were taken and compared to autoradiographs from the NPRC. A point-by-point comparison technique between the NPRC and X-rays of remains was developed. Early studies indicate that this technique can be quite powerful to identify remains. From interviews with CIL personnel, the technique is undergoing blind validation studies and there is work ongoing to partially automate the technique. Currently, CIL staff must perform the comparisons “by eye.” Automation efforts would make it possible to narrow down the number of records that would need to be compared by the scientist “by eye.” The validation tests are very important to understand the limitations of the technique and prove that the technique is robust, reliable and reproducible. Statistical work may also need to be done in order to understand the probability of a random match as opposed to a true match in order to develop confidence in the technique.



**Figure 4. Degraded Autoradiograph of Poor Quality**



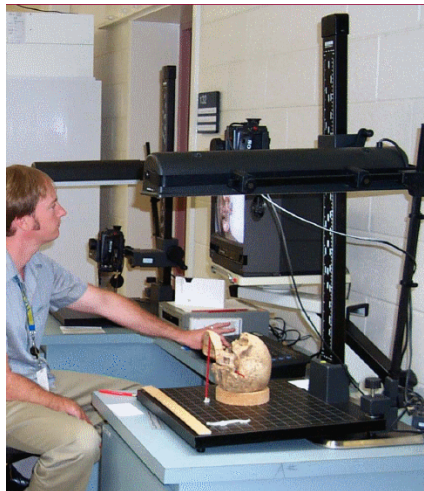
**Figure 5. Good Quality Autoradiograph**



**Figure 6. Point-by-Point Comparison of Skeletal Features with Autoradiograph**

### **b. Facial Reconstruction by Photo Superimposition**

A similar point-by-point comparison technique is also showing promise in helping identifications whereby photographs of skull remains are superimposed onto photographs of missing servicemen. A scoring system for the comparison has been developed as well.



**Figure 7. Superimposition of Subject Skull with Photograph**





**Figure 8. Superimposed Photos**

### **c. Comparison of Dental Records**

Typically, odontologists try to match dental X-rays to dental remains in order to make a link between remains and an identity. Comparison between antemortem dental X-rays and postmortem dental evidence is well-established in the community. However in some cases, the antemortem dental records of servicemen are in the form of notes or charts that describe dental work but do not contain an actual X-ray. While working at the CIL, Bradley Adams performed a statistical study using two large dental data sets.<sup>25</sup> One was a large modern military dental data set and the other was from the third National Health and Nutrition Examination Study (NHANES III). Adams established that individual dental conditions are unique or the probability of a random match was extremely low, which established that these dental records could be used as a tool for individualization. The technique has since been further validated by the CIL and automated. The forensic community at large can use a web-based tool developed at the CIL called Odontosearch, available at:

<http://www.jpac.pacom.mil/index.php?page=odontosearch&size=100&ind=2>.

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<sup>25</sup> Bradley J. Adams, "Establishing Personal Identification Based on Specific Patterns of Missing, Filled, and Unrestored Teeth," *Journal of Forensic Science*, 48: 1–9, 2003

#### **d. Comparison of Eyewear Lens Prescription with Eyewear Artifacts**

Gregory Berg, a current researcher at the CIL, participated in a study similar to the previous one except that it involved the uniqueness of eyewear prescriptions.<sup>26</sup> Vision prescriptions correct the misfocusing of light on the retina that is the result of defects in the eye. These eye defects are described as refractive errors and are measured as three variables: sphere power, cylinder power, and axis of the cylinder power. His research first determined the potential uniqueness of a particular prescription by totaling the number of biological states an eye can occupy—1,152,000—if each of the three measures of refractive error are summed (sphere power, cylinder power, and axis of the cylinder power). If the eye pair is considered, the number of biological states balloons to the square of 1,152,000, which is over 200 times the number of individuals on the earth. A statistical analysis determined the frequency of eye states in the population and determined that the most frequent refractive error (nearsightedness) occurs in less than 3% of the population.

A lensometer can measure the refractive error from lens fragments that are less than 1 cm<sup>2</sup> in area. The results from this measurement can be compared to medical records of servicemen and, if a match is determined, the probability of a random match is now known from this work. Statistical power can now give a degree of confidence in the match. Also, like odontosearch, a web-based tool, called OptoSearch, has been developed so that the greater community can access data. (OptoSearch can be found at <http://www.jpac.pacom.mil/index.php?page=optosearch&size=100&ind=2>.)

## **2. DNA-based Strategies Applicable to Formaldehyde-Treated Remains**

This section describes two DNA-based efforts—bone demineralization and molecular anthropology—which study ancient DNA and other molecules in order to classify organisms. The advances produced from these efforts might also have promise to repair DNA samples from the Punchbowl so that meaningful information might be extracted from them.

Repatriated remains from the Korean conflict have been exhumed from the Punchbowl in order to attempt to identify those remains. DNA analysis was planned in the course of these cases, and JPAC and the CIL have attempted to develop mtDNA profiles from bone samples from these remains but they have been unsuccessful. The

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<sup>26</sup> Gregory E. Berg and R.S. Collins, “Personal Identification Based on Prescription Eyewear,” *Journal of Forensic Science*, No. 52: 406–411, 2007.

Korean remains were aggressively processed with post-mortem chemicals such as formaldehyde and lye, which, at the time, was unknown to affect DNA. Lye essentially hydrolyzes the DNA, destroying it completely. Formaldehyde, on the other hand is a double-edged sword. Upon treatment with formaldehyde, DNA forms bonds with itself and any surrounding proteins by a process known as cross-linking. Cross-linking makes DNA rigid and resistant to several degradation processes that ancient DNA may be subjected to over time in the environment. However, cross-linking detrimentally affects AFDIL's procedures for determining mtDNA profiles. Specifically, cross-linking makes the double-stranded helix of DNA unable to unwind to single-strands, which is necessary for DNA to be amplified and detected by either PCR or DNA sequencing. AFDIL and JPAC have been able to extract DNA from these Korean conflict remains (albeit with difficulty) and have determined that cross-linking by formaldehyde may be the major stumbling block to getting mtDNA profiles from these samples.<sup>27</sup>

#### **a. Bone Demineralization**

Even though a great deal of the formaldehyde-treated samples in the Punchbowl may be cross-linked, a certain small percentage of the DNA may be useful for amplification. In order to purify enough of this potentially useful DNA, AFDIL has developed a protocol for extracting and purifying DNA that is about an order of magnitude more efficient than traditional casework methodologies.<sup>28</sup> The new method results in the complete dissolution of bone minerals by treating the samples with large amounts of a chemical known as EDTA. EDTA binds to bone minerals such as calcium and sequesters them to dissolve the bone. Previously, the protocol used much lower concentrations of EDTA and resulted in wash steps that discarded valuable bone powder and DNA. The result is a new protocol that has made a significant difference in several cases of DNA analysis.

#### **b. Molecular Anthropology**

The repair of ancient DNA sequences, like the ones applicable to the JPAC accounting effort, is also of interest to scientists in other fields such as evolutionary and

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<sup>27</sup> H.E.C. Koon, O.M. Loreille, A.D. Covington, A.F. Christensen, T.J. Parsons, and M.J. Collins, "Diagnosing Post-Mortem Treatments which Inhibit DNA Amplification from U.S. MIAs Buried at the Punchbowl," *Forensic Science International*, 178: 171–177, 2008.

<sup>28</sup> O.M. Loreille, T.M. Diegoli, J.A. Irwin, M.D. Coble, and T.J. Parsons, "High Efficiency DNA Extraction from Bone by Total Demineralization," *Forensic Science International*, Gen 1: 191–195, 2007.

molecular anthropologists. Molecular anthropologists study DNA sequences of populations to establish links between peoples, ancient and modern cultures, as well as extinct plants and animals. They frequently work with samples of DNA that are damaged and degraded, thus preventing PCR amplification.<sup>29</sup> Some of these problems include double strand breaks, mismatched bases, nicks, single strand nicks, and cross-linking. Much work has gone into understanding the mechanisms for DNA damage and strategies to repair such damage. While acknowledged to be very difficult, the repair of ancient DNA is possible and there have been several methods published in the literature to repair nicks, abasic sites, and even some double strand breaks.<sup>30</sup> The kind of damage faced by JPAC and AFDIL is very difficult to deal with. Cross-linked DNA requires treatment with multiple enzymes and can proceed through many different mechanisms. Creative solutions have been proposed for this problem, however. For example, one solution may utilize the ability of certain bacteria to tolerate cross-linked DNA and even exploit its ability to repair such DNA. Inserting the ancient DNA sequences into such organisms may be a way to repair damage. Alternatively, there has been substantial work in the genetic engineering of DNA polymerases so that they are able to tolerate damaged ancient DNA and more robustly amplify it.<sup>31</sup>

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<sup>29</sup> A. Mitchell, Eske Willerslev, and Anders Hansen, "Damage and Repair of Ancient DNA," *Mutation Research*, 571: 265–276, 2005.

<sup>30</sup> Ibid. G. Di Bernardo, Stefania Del Gaudio, Marcella Cammarota, Umberto Galderisi, Antonio Cascino, and Marilena Cipollaro, "Enzymatic Repair of Selected Cross-linked Homoduplex Molecules Enhances Nuclear Gene Rescue from Pompeii and Herculaneum Remains," *Nucleic Acids Research*, 30, 2002.

<sup>31</sup> M. D'Abbadie, Michael Hofreiter, Alexandra Vaisman, David Loakes, Didier Gasparutto, Jean Cadet, Roger Woodgate, Svante Pääbo, and Phillpp Holliger, "Molecular Breeding of Polymerases for Amplification of Ancient DNA," *Nature Biotechnology*, 25: 939–943, 2007.

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### **III. RECOMMENDATIONS FOR MANAGEMENT INITIATIVES WITHIN JPAC**

This chapter focuses on some potential improvements internal to the JPAC and CIL. It was noted earlier that JPAC has recently undertaken some important initiatives to expand the CIL's facilities, as well as to fully staff the CIL. We attempt here to evaluate these efforts and to describe some additional management initiatives that would build on them.

#### **A. RECOMMENDATION 5: PROVIDE AMPLE EXAMINATION TABLE SPACE IN THE NEW CIL FACILITIES**

##### **1. Growth of Lab Space**

The JPAC-CIL is in the process of expanding facility space substantially, the impact of which cannot be underestimated. During the IDA visit to JPAC, it was noted that—until the lab's extension and the addition of the second floor in Building 220—the lab had had the same amount of space as it did in 1992 when it had only 6 anthropologists.

JPAC spent \$680K to extend the existing laboratory in Building 45 by 2,000 square feet. This represents a 16% increase in total area for the lab and it doubles the critical laboratory resource of examination table space, which is used by the anthropologists to lay out and examine remains. The lab is now 14,000 square feet and all staff agree that it has helped tremendously in allowing more casework to be performed.

Building 220 on Pearl Harbor now accommodates portions of JPAC, and the second floor will be available entirely for use by the CIL. This building—which had previously been a laboratory—was provided by the Navy Facilities Command, and renovated at a cost of approximately \$1.2 million, primarily for a new air conditioning system. The CIL has also requested roughly \$300K in additional equipment purchases (for the Forensic Science Academy).

Building 220 provides almost a 100% increase in lab space compared to what is currently located in Building 45, and all table space combined will be tripled compared to

the CIL's original table space.<sup>32</sup> CIL staff will occupy the facility later in 2009, sometime after the ASCLD-LAB certification inspection.<sup>33</sup> Building 220 will eventually house certain sections of the CIL, including its own evidence handling container (an ASCLD-LAB requirement), the Forensic Science Academy and specially designated space for the K-208. The latter will offer the much needed analytical space to allow anthropologists to lay out in large groupings the estimated 300–400 sets (and sub-sets) of co-mingled remains believed to be contained in the K-208.

## **2. Adding Examination Table Space**

In terms of the ability to do case work in the existing facilities, an equipment change to expand useable examination table space could additionally increase capacity. During interviews at the CIL, the study team heard repeatedly about the challenges of trying to complete work on a case, having the report peer reviewed (which requires the case to remain on a table), and being able to respond to peer reviews all prior to the anthropologist's next deployment. If this cannot all be accomplished before the deployment, either the case must remain on the table (thereby preventing another case from being laid out) or the anthropologist must pack up the case, and then unpack it once back from deployment. Both approaches lead to inefficiencies.

An economical approach for increasing available examination table space, would be to purchase rotatable or stackable tables. When a case cannot be completed prior to the anthropologist's next deployment, this case could remain on its table, but another table placed above it which could be used by another anthropologist to lay out a different case. Even with the CIL's expanded table space, these tables would notably enhance the efficiency of case work at minimal equipment cost.

## **B. RECOMMENDATION 6: CREATE A HUMAN CAPITAL STRATEGY AND PLAN FOR THE CIL SCIENTIFIC STAFF**

JPAC has historically not experienced significant problems with manning the CIL, largely due to its world-class reputation and the ready availability of interns through the Oak Ridge Institute for Science and Education (ORISE) program. There were always more than enough applications to allow management to pick only the most qualified

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<sup>32</sup> In addition Building 287, across from 220 on Pearl Harbor, will be used by JPAC's J62 (previously at Camp Smith). It has a total of 22,000 square feet.

<sup>33</sup> This certification was due to occur in May 2009, but as of June 2009, it had not been done and use of the new space will be delayed for (at least) another two months.

interns to staff the CIL and these interns then served as the main pool for the CIL to hire permanent employees. For the last several years, however, the pool of qualified ORISE applicants has dropped dramatically, thus reducing the sources not only for the CIL's interns but also (in the longer term) for its permanent staff. At the same time, the CIL has witnessed a departure of several of its seasoned anthropologists.

To address staffing shortfalls, JPAC has pursued several aggressive personnel initiatives beginning in 2008. In addition, JPAC has commissioned a workforce survey in an effort to identify key issues to target in its recruitment and retention efforts.

There is no question that JPAC has taken significant actions to strengthen its ability to hire and retain qualified scientists. Yet, there is still significant concern among many members of the community that these actions ultimately will prove to be insufficient to build a staff that is adequate in numbers, quality, and experience. While term positions, for example, could help to fill empty vacancies left by ORISE fellows, a more fundamental hurdle is the inability of the lab to retain mid- and senior-level managers with sufficient experience and expertise to lead the CIL when the current generation of managers retires. Similarly, while the aggressive recruiting efforts may be effective in attracting young personnel to the CIL, there is concern that retention efforts will not be sufficient to overcome some of the disadvantages voiced by several mid- and senior-level interviewees, many of which relate to its Hawaiian location.

A systematic human capital strategy is needed to determine staffing requirements, to evaluate the sufficiency of current initiatives, and to identify any additional actions needed to ensure JPAC can build a staff that is adequate in numbers, quality, and experience. The major elements of such a strategy are discussed here.

## **1. JPAC Survey Findings**

The JPAC staff survey mentioned earlier provides valuable context for determining the issues that the human capital strategy will need to address. The survey asked a number of questions to gauge employees' satisfaction with the current workplace environment. It is noteworthy that 75% of the JPAC CIL staff would recommend employment with JPAC to a friend. Many caution, however, that the CIL is not for everyone and they would be sure to make clear the advantages and disadvantages of working there.

Survey respondents cited many positive aspects of working at JPAC. First and foremost is the importance of the mission itself. Respondents also cite opportunities to



use scientific skills, to interact with others in the lab, and the prestigious reputation of the lab. Among the negative aspects cited are: the military-civilian/scientist cultural disconnect, the need constantly to train up inexperienced, new military personnel in the field; the desire to be treated with respect both within JPAC facility and in the field; and finally, the location of the CIL in Hawaii.

The majority of respondents do not want to work at JPAC for more than 10 years; 75% of survey respondents said their position on this is “influenced” by the CIL’s location in Hawaii. The interviews conducted by the IDA study team identified a number of common issues across the CIL staff regarding the shortcomings of living and working in Hawaii over an extended period of time. These include the sense of isolation from professional and academic institutions valued for career development; the poor school systems available for their children; inadequate opportunities for spouses’ employment in the local economy; the high cost of living; and the distance from family on the mainland. Many believe that within plausible bounds, additional pay or benefits will not overcome these disadvantages for many individuals. These perspectives suggest that it will be difficult, and perhaps expensive, to craft a human capital program that will sustain a sufficient cadre of senior, experienced CIL scientists over the long haul. On the other hand, there are relatively small numbers of individuals involved and JPAC possesses a great deal of flexibility to design a program that is tailored to the challenge at hand.

## **2. Recruitment**

JPAC has begun to make better use of government employment websites, always maintaining an active recruitment announcement on the web. This information has also been forwarded to several board-certified anthropologists for the purpose of further dissemination in the hopes of recruiting personnel who may not have heard of the CIL. JPAC leadership has sought to increase exposure of the CIL in other ways as well. Staff have attended several anthropology conferences (most recently at the Forensic Anthropology conference in Denver) where they have set up prominent booths to advertise the lab to prospective candidates. This has been a fruitful effort, yielding a number of applications and one planned new hire as a result of the Denver conference. CIL staff have similarly visited universities with prominent anthropology departments to increase awareness of the CIL as well as aggressively pursuing ORISE fellows. Finally, in order to expedite the hiring process which often takes months, JPAC is seeking direct hire authority, citing the difficulty in filling unique anthropological positions by DoD writ large.

### 3. Retention

While almost half of the respondents have been directly affected by personnel or quality of life initiatives undertaken in the last year (according to the results of the survey), there is no indication that they are what is needed to convince anyone to stay.

Beginning in 2008, JPAC instituted a number of initiatives aimed at addressing issues expressed by departing CIL staff. First and foremost, this has entailed efforts to adjust the amount of deployed time for deployable anthropologists, specifically reducing the number of missions performed by each anthropologist and thus the overall number of days spent deployed. (Deployment issues are discussed in the following section.)

JPAC's efforts to retain CIL staff have also focused heavily on financial incentives, such as tuition assistance and student loan payback,<sup>34</sup> a 10% retention bonus for deploying anthropologists (which began to be paid out in 2008), and a current effort to secure a Local Market Supplement (LMS), which is in addition to the 25% COLA. The LMS is currently being coordinated with the Office of Management and Budget (OMB) to allow up to a 25% increase in pay for a maximum of 4 years, citing the extreme conditions when deployed. Assuming OMB approves this request, JPAC will submit for an Unfunded Requirement (UFR) which would likely be approved given the relatively small amount of money. Particularly with these initiatives, CIL salaries appear to be commensurate with other market competitors.<sup>35</sup>

JPAC has also expended significant effort to develop a new tier of management positions ("YA-"), designed for entry level, "journeymen" and senior-level managers. It is believed that such a tiered approach will provide sufficient compensation and upward mobility thereby enhancing retention at the CIL, including at the senior levels. JPAC has also pushed for converting the CIL Director position to a Senior Executive Service (SES) slot to add yet another opportunity for promotion. JPAC is also looking into establishing

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34 It has been noted, however, that while the tuition repayment program offers up to \$10,000 per year for three years, this money is taxed so that the recipient effectively gets on the order of \$18,000 rather than \$30,000. Moreover, anyone who leaves in less than 3 years is required to pay back the full amount of \$30,000.

35 It should be noted that the 25% COLA which is allowed for Hawaii does not count toward retirement, although neither does it count within a salary cap nor is it taxed. While a tax-exempt COLA may typically be more attractive to younger personnel, the fact that it does not count toward retirement pay level may be a significant deterrent for more mid- to senior-level personnel (the type JPAC is trying to attract). Replacing COLA with Locality Pay (which does count toward retirement, but is taxed), is an issue under consideration in Congress.

Term Positions in lieu of the ORISE program, which would offer the temporary employee the same benefits given to permanent staff.<sup>36</sup> Furthermore, if the employee worked out well, JPAC would be able to convert the employee noncompetitively to a permanent position.

Lastly, in August 2008, the CIL established the Forensic Science Academy (FSA), partly in response to the declining number of ORISE applicants and partly to afford some teaching opportunities to the staff. One semester each year, the FSA will train graduate forensic anthropology students in the types of skills required by the CIL.<sup>37</sup> This will also offer students the opportunity to work with CIL staff, gain hands-on experience and, at least in some cases, ideally apply for permanent positions at the CIL upon completion.

### **C. RECOMMENDATION 7: IMPROVE MANAGEMENT TO REDUCE THE STRESS OF DEPLOYMENT SCHEDULES**

Earlier years' Operational Plans (OPLANs) (dating back to 1999) were designed for people to deploy 4–5 times/year. This operating tempo was created at a time when most anthropologists were military, so deployments were not seen as excessively high. However, now the lab is predominantly civilian (military anthropologists from the Army Corps of Engineers are no longer available). The JPAC survey shows that 16 of the CIL's deployable personnel who responded to the quality of life survey reported that they were deployed at least 90 days in 2008. About half of the 24 total respondents think the amount of time deployed is about right and about half think it is too much. In one case, a CIL scientist expressed appreciation for the command's efforts to reduce the amount of time deployed, noting that it had been cut back from the previous year's 200 days deployed.

In addition to the impact frequent deployments have on the staff's personal life, impacts on their work in the lab are also significant. First and foremost, deployments can seriously disrupt anthropologists' case work schedules. Often anthropologists will be required to deploy while in the middle of performing skeletal analysis on existing cases. At such times, they must set aside their analysis and pack the skeletal remains away. Not only is this time-consuming, but they must unpack it yet again when they return from their deployment (assuming there is table space available) and recommence analysis.

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<sup>36</sup> They would receive retirement, medical coverage, sick leave, etc., which ORISE fellows do not.

<sup>37</sup> During the other semester, the FSA will be used for training with international colleagues.

Significant momentum may be lost due to this disruption, exacerbated by the chance that table space may not be available.

Second, in addition to deployments and casework, anthropologists must also serve as peer reviewers for other anthropologists' casework. One interviewee indicated that he/she had performed almost as many peer reviews as their own field reports in a quarter, in addition to regular analytical work. The time commitment for such a review is approximately equal to the time commitment for conducting analyses on the original case (two to three weeks) and almost always requires several iterations. While this review is of critical importance for ensuring the quality of CIL analyses, it illustrates the multiple pressures imposed on deploying anthropologists.

Adjusting deployment schedules to reduce the number of days away from the home station as well as increasing the amount of dwell time at home and in between missions is a significant step toward addressing this issue.

#### **D. RECOMMENDATION 8: REBALANCE THE PERSONNEL MIX AT THE CIL TO MAKE MORE PRODUCTIVE USE OF SCIENTIFIC TALENT**

As part of the overall Human Capital Strategy for the CIL, there are several near-term staffing actions that could be taken to enhance the efficiency of the CIL's operations and therefore help accelerate the identification rate, to include:

- hiring non-deploying anthropologists,
- reinforcing the use of lab technicians,
- allowing current CIL managers to do more case work by freeing them from some managerial duties.

First, while at least some deployable anthropologists would prefer to spend less time in the field, they do not wish to eliminate that aspect of their jobs entirely. They were hired to do both lab work and excavations and want to continue to do both. At the same time, the study team did not hear any objections to the idea of JPAC hiring more non-deploying anthropologists who could then spend all their time doing case work in the lab. Those interviewed did not believe this would cause resentment among those who do deploy because the expectations of job responsibilities would be clear from the outset. Non-deploying positions might, furthermore, be of interest to middle- and senior-ranking anthropologists who are no longer physically fit for the stringent demands of JPAC site excavations. These non-deploying positions would ideally be used to focus on a specific set of cases, such as the K-208 or perhaps excavations from the Punchbowl.

The continued, and possibly expanded, use of lab technicians also merits careful consideration. With a mentorship program such as the CIL has created, lab technicians can make important contributions in accelerating the skeletal analysis component of the CIL's work. Their work thus expedites the forensic anthropologists' overall work on cases. Because lab technicians do not deploy, continuity of work is also enhanced. While most lab technicians would not be interested in remaining in this position as a long-term career because it would offer little growth potential, it is reasonable to expect someone to stay three to five years, which provides them valuable experience and the CIL augmented, lower cost, and consistent case work support.

As is the case in many organizations, promotion opportunities for good performance and seniority within the CIL come in the form of managerial positions. The management positions were, in fact, created to offer better opportunities for professional growth. Nevertheless, this has created at least two "difficulties": these skilled forensic anthropologists no longer have nearly as much time to dedicate to case work in the lab and they are not trained in managerial skills. Taking them away from case work naturally reduces the lab's throughput. A more efficient approach might be to create a new position for a trained manager (with adequate scientific background to understand the CIL's operations) and to assign some of the purely management functions to this manager. While some managerial functions should remain with current managers due to their scientific skills, relieving them of some administrative burdens would allow greater use of their real expertise: to contribute to more identifications. A trained manager would also be able to better address concerns expressed by a number of the CIL staff about the inability or unwillingness of current managers to adequately address personnel problems.

#### **E. RECOMMENDATION 9: DELEGATE AUTHORITY FOR PREPARING IDENTIFICATION MEMOS**

An important near-final step in the identification process is the preparation of the identification memorandum to which all the supporting documentation that contributed to the identification is attached. This comprehensive package is then submitted to the appropriate SCO for presentation to the family. At the present time, the only person with the authority to prepare the identification memorandum is the Scientific Director of the CIL. Even at the current rate of annual identifications, having this authority rest in the hands of only one individual can and has delayed the CIL's out-processing of identification packages to the family. Although such delays are understandable in the context of the Director's range of duties, including those requiring time out of the office, this process needs to be altered.

Assuming the target of 180 identifications per year over the next five years, someone else in the CIL—the Deputy Director or one of the managers—must also be given the authority to prepare identification memorandum, at least when the Director is not available to do so. In fact, simple mathematics suggests that two people should have this authority at all times, even if both are present in the CIL when a package is ready for this memorandum to be prepared. Based on annual number of work days less federal holidays and four weeks' vacation/sick leave, the current system would require the Director to prepare one of these memorandums almost daily (180 identifications in 226 work days).

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#### **IV. A NEAR-TERM, TASK-FOCUSED INITIATIVE TO ACCELERATE IDENTIFICATION RATES**

The IDA study team considered a number of alternative initiatives for increasing the annual rate at which the accounting community identifies the remains of missing Americans from prior conflicts. The task order specified several factors to be considered including: a) command relationships for the identification laboratory, b) the future location of the laboratory (in Hawaii versus on the mainland), and c) the creation of a satellite facility versus maintaining a unified laboratory. The target of 180 identifications per year, as stipulated in the task order, was set as the goal for the study.

To provide a systematic framework for describing and assessing alternatives consistent with the laboratory's workload and national policies, the IDA study team evaluated options for two separate time horizons. We focus first in this chapter on a possible near-term initiative aimed at resolving pending Korean War cases in the CIL within the next three to five years. In the next chapter, we consider longer-term alternatives addressing the steady-state workload following the drawdown of those cases.

##### **A. RECOMMENDATION 10: DEVELOP AND ASSESS A PLAN FOR A NEAR-TERM INITIATIVE FOCUSED ON PENDING KOREAN WAR CASES**

Several of the scientists and JPAC officials interviewed for this study advocated creating a task-organized activity focused on resolving the Korean War cases pending in the laboratory. This initiative within the JPAC CIL would complement the pending effort to accelerate the collection of FRS for the SEA and Korean conflicts.

As discussed earlier, there are 252 Korean War accessions within the CIL, which are believed to include the remains of over 400 U.S. service members. Of these accessions, the "K-208" accessions turned over to the United States by North Korea represent a majority; they are particularly challenging due to the large number of individuals whose remains are co-mingled. Several of the scientists familiar with the situation believe that completing the collection of available FRS for the Korean conflict, combined with increased laboratory space and a few additional scientists, would allow the laboratory to identify a large fraction of these Korean War cases in a period of three to five years.



## 1. Concept

A rough plan illustrating this idea is presented here with the underlying calculations provided in Appendix B. This illustration represents a composite of the potential approaches suggested by various experts. Common to these approaches is the conviction that a relatively small, focused effort could yield substantial progress, both in terms of the annual rate of identifications and in terms of reducing the number of pending cases in the laboratory. The plan incorporates the following assumptions and elements:

- It comprises a small team (five or six people) dedicated to ID activities (with limited or no deployments except for training and career development purposes).<sup>38</sup>
- The team is focused on a defined task (initially resolving pending Korean War cases), and the initiative is limited to a duration of five years.
- The team comprises a mix of experienced scientists, junior scientists, and technicians.
- The initiative is provided ample space dedicated to the assigned task, in a facility that is ASCLD-LAB certified.
- The team is responsible for coordination both with the SCOs in setting priorities for FRS collection and with AFDIL on priorities for DNA analysis.
- The initiative requires only limited, specialized equipment.
- Each team member (scientist or technician) would have an identification rate of six cases per year (see Appendix B for the underlying calculations).

The estimated identification rate per analyst for the initiative is double the average rate of identifications per anthropologist in recent years (2.9 per year from 2000 to 2008). This assumed level of productivity is realistic for such a task-focused initiative because:

- The remains in the CIL have already undergone preliminary screening and DNA sampling;
- The FRS surge initiative will provide a key basis for identification;
- The initiative will have adequate space dedicated for examining the accessions involving the remains of large numbers of individuals;

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<sup>38</sup> There are currently 22 authorized billets for anthropologists (due to the recent addition of four Navy billets) with only 14 of these filled. Coupled with the utilization of new lab space in Building 220, filling the remaining vacancies with non-deployable anthropologists could result in significant progress toward increasing identifications. However, the difficulties of hiring more non-deploying anthropologists include making the position attractive enough for a mid- or senior-range person (assuming the CIL remains entirely in Hawaii) and the fact that non-deploying anthropologists would fail to address the challenges of some anthropologists spending too much time deployed. (It is a command objective for deploying anthropologists to average two deployments per year.)

- The assigned scientists and technicians will be dedicated to the task, without the distraction of deployments.

## **2. Illustrative Models**

Table 6 summarizes two possible models for the proposed near-term initiative. We have outlined alternatives for locating the initiative in Hawaii or on the mainland, because the future location of the activity is an important issue debated within the accounting community. We have assessed the relative cost and effectiveness of locating the activity within the JPAC Hawaii facilities versus locating it on the East Coast of the mainland. The major considerations are highlighted in the table and discussed below.

### **a. Total Costs**

The cost assumptions and calculations for the initiative are presented in Appendix B. Total costs are estimated to be in the range of \$1 to \$1.3 million in either location. Facility costs would be lower in Hawaii than on the mainland, but these costs would be offset partially by the greater costs of hiring and retaining personnel in Hawaii.

### **b. Recruitment and Retention of Scientists and Technicians**

The scientists interviewed for the study believe that only a small additional staff is required to execute this initiative. Consistent with this thinking, we have assumed a staff of five scientists. It is assumed that a satellite facility would require that an additional Deputy Director position be established for the JPAC CIL. This person would be an experienced CIL scientist who would assume responsibility for quality control and management of the task-focused activity. The cost of this additional person partially offsets the per-person cost advantages of the mainland location.

**Table 6. Description of a Three-to-Five Year Initiative Dedicated to Resolving Pending Korean War Cases**

Evaluation Factor	Hawaii	Mainland
Total Cost	\$1 to \$1.3 million in either location*	
Recruitment and Retention of Scientists and Technicians	5 Scientists	5 Scientists; 1 Deputy Director; .5 Admin Advantages: Mainland employment costs are substantially lower due to HI COLA, hiring incentives, retention incentives Advantages: It will be easier to staff the initiative on the mainland, given the difficulty JPAC has experienced in attracting and retaining mid-career and senior scientists
Facilities	Refurbished Building 220 at Pearl Harbor Advantages: Building 220 facilities startup costs have already been funded and expended; the mainland facility entails costs for startup and ASCLD-LAB certification	5,000 to 7,000 sq. ft. leased commercial space
Efficiency and Effectiveness of Recovery Operations	In both locations, a team focused on identification activities would have minimal involvement in recovery ops; therefore co-location within JPAC is not a significant advantage for efficiency of recovery operations. Neither location: Would disrupt command relationships Would disrupt recovery op relationships	
Efficiency and Effectiveness of Identification Activities	In both locations, the initiative focuses on a discrete set of cases which can be worked independently of other CIL cases. Advantages: Co-location in HI within JPAC fosters unity of effort among JPAC CIL scientists and technicians	Advantages: Provides a mainland base of operations, which should strengthen relationships with Service SCOs and AFDIL
Startup and Relocation Cost	Advantages: Building 220 is scheduled to complete certification in 2009; no additional expenditure is needed to support the initiative or relocate staff	Satellite startup and relocation costs: Facility Outfitting = \$250K Lab Certification = \$132K Relocation of Deputy Director = \$35K

\* See Appendix B for cost assumptions and calculations

As discussed in Chapter III, JPAC has been unable to fully staff existing billets in recent years and consequently several new recruiting and retention initiatives were introduced in early 2008. Several additional hires have been made in the last year but there remains the question of whether these recent actions will prove sufficient. To provide a systematic framework for assessing the current situation, evaluating alternatives, and charting a future direction, Chapter III recommended the creation of a JPAC CIL human capital strategy. Such a strategy is needed to establish the education, training, and experience requirements for JPAC CIL scientists and technicians.

Recent personnel trends suggest that JPAC is able to recruit capable new graduates and retain them in the early years of their careers. The major challenge has been to develop and retain sufficient experienced, mid- to senior-career level scientists to provide the needed cadre of intellectual leaders and mentors for the more junior staff. An important purpose of the human capital strategy would be to identify the management tools needed to attract, develop, and retain this core of mature and experienced scientists to lead and manage the laboratory.

Adding five more scientists for this near-term initiative will further increase the challenge of creating a sufficient senior cadre of scientists. To account for this, the personnel cost assumptions for locating the focused initiative in the Hawaii location assume an aggressive program of pay and incentives targeted at a small handful of senior scientists. The intention of this targeted incentive strategy is to solve the problem of retaining mature, experienced scientists at the minimum total cost. The pay and incentive assumptions are summarized in Table 7. It should, nevertheless, be noted that a number of those interviewed indicated that financial incentives—no matter how generous—would not solve the retention problem.<sup>39</sup>

**Table 7. Pay and Incentive Assumptions for Task-Focused Initiative**

	<b>Hawaii</b>	<b>Mainland</b>
COLA	25% all lab staff	0
Hiring Incentives	\$25,000 per senior scientist \$12,500 per scientist	0
Retention Incentives	15% for senior scientists \$25,000/yr senior scientists	0
Education Assistance	\$25,000 for any lab staff	0

<sup>39</sup> The JPAC Survey (Appendix C) finds no cases where pay or compensation are the major determinants of JPAC CIL scientists' employment choices.

One-time payments, such as hiring incentives and education assistance are amortized over five years. Five year amortization is also assumed for relocation costs.

The personnel cost estimates for the near-term initiative include an indirect cost element, which reflects such non-pay costs as personnel administration and benefits. The factor used is 60 percent of salary.<sup>40</sup>

### **c. Facilities**

The cost comparisons assume there are no additional facility costs for establishing a task-focused initiative in Hawaii. This is because JPAC recently has expanded the laboratory spaces and acquired substantial additional laboratory space in Building 220 within the Pearl Harbor complex. The Command has already funded \$680,000 to expand the lab in Building 45, and an additional \$1.2 million to upgrade all of Building 220 for JPAC's use. This building will provide 11,000 sq. ft. of additional laboratory and classroom space on the second floor, of which about 5,000 sq. ft. will be available for the task-focused initiative.

Establishing a mainland facility would require funding for needed improvements, equipment, and for obtaining ASCLD-LAB certification. A building of 5,000 to 7,000 sq. ft. is considered sufficient to work efficiently on the Korean War cases. If this new facility were established, JPAC would have available for other purposes the approximately 5,000 sq. ft. of space on the second floor of Building 220. This is an intangible benefit that is not factored into the comparisons.

In order to provide a common yearly cost basis for comparisons, we have amortized the one-time costs for improvements and ASCLD-LAB certification over a five-year period, and combined this annualized cost with the estimated yearly rental costs.

### **d. Efficiency and Effectiveness of Recovery Operations**

As described earlier in this paper, both recovery operations and identification activities involve the work of a number of organizations, including all of the sub-elements of JPAC, elements of USPACOM, the SCOs, and AFDIL. The quality of the working relationships among these organizations is a strong determinant of the overall

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<sup>40</sup> USAF cost factors.

efficiency of the recovery and identification activities, and must therefore be considered in evaluating alternative locations.

The value of co-locating the scientists and technicians within the JPAC facility has been debated vigorously within the community. The JPAC leadership advises that the recovery operations process benefits from close collaboration and frequent interaction between the scientists in the CIL and the JPAC J-2 research and investigations of prospective recovery sites, JPAC annual planning for recovery operations, and the planning and preparations for individual recovery operations. Counter to this view are the following observations: a) the lead scientist for recovery operations rarely spends significant time with the military team members prior to departures; b) interactions with the JPAC J-2 are most commonly conducted by email; and c) the JPAC employs a “blind” ID process that precludes communication on a case between those who recover the remains from the field and the anthropologist responsible for identifying the individual back at the CIL.

We have assumed the staff assigned to the near-term initiative would focus almost exclusively on identification activities. They would have little or no involvement in recovery operations. One reason for this is to maintain focus on identification activities without the disruptions associated with deployments for recovery operations. A second reason is that, if the near-term identification activity were to be located on the mainland, minimizing involvement in recovery operations would avoid the costs and inefficiencies associated with staffing recovery teams with scientists who are not co-located within the JPAC Hawaii facility.

#### **e. Efficiency and Effectiveness of Identification Activities**

The key external relationships for the scientists focused on identifications are those relating to coordinating and prioritizing the support of the SCOs, AFDIL, and the LSEL. One finding noted in the earlier chapters is that the effective use of DNA methods requires substantial improvements in the working relationships among the CIL, the SCOs, and AFDIL in the employment of advanced DNA methods for identification. Communication today is inhibited by travel time and expense, as well as by the difference in time zones, which limits the daily window for communications. Scientists focused on identifications could communicate more often and more easily if the lab were located in or near the same time zone as the SCOs and AFDIL. (Of course, this does not resolve the communications and command relationship problems noted earlier.)

By focusing the initiative on a discrete set of identification tasks, the need for routine interaction with the remainder of the scientists and technicians in the JPAC CIL is significantly reduced. As a discrete identification activity, it would become a repository for a complete set of relevant records and investigation reports, and assume responsibility for its quality control processes. The Deputy Director responsible for the activity would coordinate with the Scientific Director in the final certification of identifications, and in carrying out mentoring, career development, and staff management actions.

If the initiative were co-located within JPAC in Hawaii, it would be possible to maintain professional ties between the scientists assigned to the initiative and those responsible for the mainline CIL activities. The risks of establishing the initiative on the mainland are that the few scientists in the mainland activity would be isolated from their colleagues at JPAC and that their practices may drift from the rigorous approach developed and applied in the JPAC CIL. This risk can be mitigated by assigning a seasoned Deputy Director to lead the initiative, by implementing sufficient training, and by requiring occasional recovery missions and visits to the parent lab for the scientists in the satellite facility.

#### **f. Startup and Relocation Costs**

The transition costs normally associated with the relocation of an activity include the loss of personnel who choose not to relocate, downtime in operations, and the logistics costs of finding and modifying facilities, moving equipment, and relocating people. Much of the debate surrounding the future of the CIL has focused on these potential costs. The creation of a satellite facility for a focused initiative avoids most of these costs.

### **3. Detailed Design and Location**

Several additional steps are required to translate the concept for the near-term initiative into a workable plan.

- Complete the human capital strategy recommended for the CIL. This will provide a more precise estimate of the personnel costs required to add five more scientists and technicians, as well as the differential in costs between Hawaii and the mainland.
- Conduct the market research necessary to evaluate the costs associated with alternative sites.
- Create and cost plans for alternative sites and conduct an analysis of alternatives.
- Decide on the location and commission detailed planning.

Of all the factors discussed, two factors are the important drivers of the choice of location: First and foremost, is the cost of personnel and the feasibility of creating a balanced and effective staff in each location. The key question to be addressed through the development of a CIL human capital strategy is whether it is feasible to attract and retain the right mix of scientific talent, and if so, is the cost prohibitive relative to the costs of a mainland operation. The illustration here includes aggressive incentives for senior scientists under the assumption that such incentives would be sufficient to build and retain the needed staff. The belief is that it would be possible to attract and retain more experienced personnel at a mainland facility, and thus additional incentives would not be required.

The second key driver of the choice of location is the tradeoff between the advantages of having the identification activity near AFDIL and the SCOs, and the disadvantages of having a small staff isolated from its parent organization. The argument for locating the activity on the mainland is that it should be possible to retain close working relationships with the parent lab through personnel assignments and training activities, while at the same time improving working relationships with AFDIL and the SCOs.



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## **V. LONG-TERM MISSION NEEDS, COMMAND RELATIONSHIPS AND LOCATION**

The near-term initiative proposed in the preceding chapter is designed to resolve almost half of the pending identification cases now in the CIL. If this initiative were successfully completed in three to five years and the rest of the CIL maintains its current annual rate of identifications, the work of JPAC and the CIL could then transition to a sustained program of new research, recoveries, and identifications. Over time, there would emerge a rough balance in activity rates across the major elements of the identification process: research, additions of approved recovery sites, the execution of recovery operations, the addition of accessions at the laboratory, and the completion of identification activities.

This chapter considers the challenge of defining the capabilities that would be needed for achieving a sustained rate of 180 IDs per year, consistent with the goal incorporated in the study tasking. The capabilities and investments in the CIL needed to meet the target are highly sensitive to the following key policy choices and external factors:

- The national policy on phasing down Southeast Asian research and recovery efforts
- The national policy on WWII recoveries, to include
  - Responsive versus proactive recovery site identification, and the number of WWII sites referred to DoD by civilians and other governments
  - The policy for over-water incident recoveries
- Access to North Korean sites

Three management initiatives will also shape the character of future work and the ability of the laboratory to complete identifications. These are:

- Investments to develop new technologies or modify existing ones to enable identification of “challenging” remains, such as those from the Korean War in the Hawaiian Punchbowl Cemetery;
- The availability of FRSs, and the efficiency of the FRS collection process; and
- JPAC’s ability to develop and execute an effective human capital strategy in order to build a sufficient cadre of senior talent.

Two simple examples illustrate the sensitivity of workload to these variables. At one extreme, the continuation of current practices would require a rough doubling of resources to increase the rate of identifications to 180 per year. At the other extreme, several experts told the IDA study team that identifications could be increased to 180 with no additional resources if priorities were shifted to focus primarily on WWII cases. Furthermore, the needed methods and the mix of skills within the CIL would vary significantly across alternative future scenarios.

Lacking the resolution of such key factors as these, it is premature to develop and evaluate concrete investment alternatives for the future of the identification laboratory. Instead, a logical and more practical approach entails first an effort within the accounting community to resolve these planning priorities.

#### **A. RECOMMENDATION 11: CREATE A LONG-TERM EXECUTION PLAN**

An appropriate mechanism to facilitate the resolution of the planning issues would be to undertake a strategic review designed to clarify the accounting mission priorities, to understand and bound the planning factors outlined above, and to examine the implications for workload and needed capabilities across the accounting community. This could take the form of a DPMO-led long-term mission execution plan for the prior-conflict accounting mission. Such an execution plan would complement the Strategic Plan recently issued by the accounting community.<sup>41</sup> The remainder of this section offers observations on a few of the more important planning factors that would need to be addressed.

##### **1. Conflict Prioritization as a Key Planning Factor**

The priority assigned across conflicts is an important policy decision that will drive the workload across the accounting community.

###### **a. Phasing Down Recovery Operations in Southeast Asia**

Historical policy guidance for prioritization of conflicts made recoveries in Southeast Asia the highest priority. This is a result of the fact that the impetus for the accounting mission stems from the Vietnam War and the desire to repatriate all missing servicemen involved in that conflict. This was known as the “10-5-10” policy, translating into ten recoveries for SEA, five recoveries for Korea, and ten to be performed worldwide (the latter had mainly been for World War II, but were also used to augment

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<sup>41</sup> Senior Study Group, *Personnel Accounting Community Strategy* (2009).

recoveries in North Korea, until access was terminated in 2005). JPAC has further prioritized WWII recovery efforts to comply with congressional guidance to pursue aviation losses in the southwest Pacific, particularly Papua New Guinea. More recently, policy guidance has been to develop “case prioritization criteria that takes into account time passage, changing political and geographical conditions, and the probability of successful resolution.” This document further stipulates that:

We need to focus our efforts where they will yield the best results... Given our goal to account for as many Americans as possible, we should base our efforts on the potential for success and the risk of losing access to potential remains at particular sites, rather than on a ranking of individual conflicts... A level of effort that allocates resources based on predefined percentages or on prioritization of conflicts is not an effective means of achieving the fullest possible accounting of missing Americans. Such methods provide little flexibility in the face of a changing mission environment and do not account for the challenges unique to particular countries, regions, or conflicts. Rather than using arbitrary measures, the community needs to define a level of effort that is condition-based and focused on maximizing mission success within the constraints that are outside of our control.<sup>42</sup>

While annual identification rates were once very high for Southeast Asia (reaching 67 in 1989), the average over the last five years (2004–2008) has been 26 annual identifications. This partly reflects the fact that the remaining recovery sites in Southeast Asia are the most difficult ones, and only 40% of recovery operations for Southeast Asia are now yielding remains. This trend is expected to continue and there are increasingly questions about whether JPAC’s resources could be more fruitfully applied to recoveries for other conflicts where remains recoveries are virtually guaranteed. Moreover, the environmental conditions in Southeast Asia are such that, even when remains are recovered, they are not always viable for analysis due to their degradation. And while there are still 186 Southeast Asian sites approved for excavation, many of these have been excavated before and the probability of recovering remains is less promising than Korean War or WWII sites.

The experts in JPAC conclude that the long-term potential to expand the list of recovery sites is very limited, as is the long-term potential for substantial numbers of additional identifications. Informed opinion is that there will likely be no more than 100 to 150 additional service members identified for that conflict (of a total remaining 1742 unaccounted for).

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<sup>42</sup> Ibid.

The pace of recovery operations in Southeast Asia is limited by geography, the weather, and political factors. JPAC believes it is practical to assume that, under current policy and the current level of effort, recovery operations could be completed in about 10 years. Moreover, beyond that time frame, continued environmental degradation of remains will make finding additional remains increasingly unlikely. Thus, within that timeframe, the JPAC will have essentially completed the mission for Southeast Asia.

Therefore, the simplest way to increase identifications without reducing the number of Joint Field Activities (JFAs) would be to redirect resources from Southeast Asian recoveries to field operations for the other conflicts with a higher probability of remains recovery. Unless access to North Korea is granted (which holds several thousand additional cases),<sup>43</sup> these resources would be directed towards increasing the number of JFAs in the South Pacific for air losses during World War II, as well as Europe and perhaps South Korea. Recovering more WWII sites would be fruitful because of the typically larger numbers involved with one site (often reaching as high as 20) and the comparatively low cost.

#### **b. Resuming Recovery Operations in North Korea**

In Korea, the potential for future recovery operations is very different in the North versus in the South. South Korea is similar to Southeast Asia, in that there is very limited potential for additional recovery operations, due in part to the fact that infrastructure development has literally built over some recovery sites. Since 2005, when access to North Korean sites ceased, JPAC has average only 13.5 new accessions per year (biological and material evidence) for the Korean War.

North Korea, in contrast, contains a large number of potential recovery sites, which could yield substantial numbers of identifications. Access, of course, would require a substantial thawing of U.S.-North Korean political and diplomatic relationships. In addition, there are some 800 unidentified Korean War Service members who are buried in the Hawaiian Punchbowl Cemetery. All told, the experts in JPAC believe that renewed access to North Korea and the development of effective identification methods for the Hawaiian Punchbowl cases would yield a maximum long-term potential to recover and identify about 2,000 of the 8,146 Korean War MIAs.

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<sup>43</sup> According to figures provided by DPMO, within North Korea more than 1,200 missing servicemen are believed to be at three main POW camp burial sites, 1,559 in the Unsan/Chongchon area, and about 1,150 in the Chosin Reservoir Area.

North Korea had been the source of the vast majority of Korean War excavations until access was terminated in 2005. Since then, JPAC has focused its accounting efforts for the Korean War on remains already recovered and currently located in the CIL or from the Punchbowl Cemetery. Should access to North Korea be granted, negotiations and deployment preparations would likely take over a year before JPAC staff could reasonably be expected to begin recoveries. Nevertheless, once begun, such recovery operations should yield sizable numbers of remains, since over half of those missing from the Korean War are located in North Korea, many in large concentrations.

### **c. Policy for WWII Recoveries**

There are over 80,000 WWII-era unidentified or missing U.S. Service members. The majority of these individuals were lost over deep water or they have been interred in National Cemeteries as “unknowns.” JPAC experts estimate there may be as many as 20,000 individuals who could eventually be recovered and identified. Presently, the national policy is to pursue recovery operations only in response to information provided by non-governmental sources or foreign governments. That is, the DoD is not undertaking proactive research to identify and investigate potential recovery sites.

JPAC J-2 analysts indicate there is no shortage of volunteered leads coming from external sources to enable researchers to develop and nominate additional WWII recovery sites. It is their view that, if such leads were aggressively pursued, WWII recovery cases, alone, could fully occupy JPAC recovery teams and the JPAC identification lab for the foreseeable future.

### **d. Exhumation of the Punchbowl**

The National Memorial Cemetery of the Pacific (The Punchbowl) contains the buried remains of 860 unknown servicemen from the Korean War (as well as over 2,000 unknown servicemen from World War II). These Korean War remains represent roughly 10% of the total unaccounted-for servicemen, and approximately 50% of unaccounted-for servicemen when excluding those cases in North Korea, over water, or already in the CIL.<sup>44</sup> The remains of these servicemen have, to date, been unidentifiable due to the cross-linking of DNA with the formaldehyde treatment they received when being embalmed. However, recent developments in science and technology hold promise for the eventual identification of these remains.

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<sup>44</sup> It is estimated that there are approximately 4,400 missing servicemen throughout North Korea in POW march routes and camp burial areas, ground battle locations, and crash sites.

A new technique developed by the CIL in recent years involving chest X-rays taken from Korean War servicemen holds significant promise, as described in Chapter II. Comparisons of induction X-rays with skeletal remains exhumed from the Punchbowl have yielded impressive results but the process is laborious and very time consuming. To address the latter, the CIL is working to automate the X-ray matching process to a certain extent so that the number of possible matches that need to be assessed by the scientist can be significantly narrowed down; this would appreciably expedite the process. It is estimated that this capability could be developed in the next one to two years. Already by using this comparison technique, the CIL has been able to identify six sets of Korean War remains and the staff has every reason to believe that it will be able to be used to yield several hundred identifications from the Punchbowl in the future.

## **2. Workload Implications**

### **a. Research Efforts**

If the number of identifications is to be significantly increased over the long term, it will ultimately be necessary to increase the number of sites identified for excavation. This would require increased manpower (in the form of more historians) devoted to World War II and Korean War research.

Research on Korean War losses could take several forms. DPMO and JPAC could utilize additional historians and analysts to investigate cases in both South and North Korea. For those in South Korea, JPAC could seek to use U.S. Forces Korea (USFK) resources to assist in preliminary site assessments. This approach would help to expedite recovery operations should North Korea grant access to JPAC.

One level of effort for World War II could be to continue current policy, but with additional resources. Namely, this would be to conduct research that would seek to validate information provided by interested citizens in order to place those sites on the list for further action. A second level of effort would be to expand DPMO's and JPAC's capacity to proactively research WWII sites, beyond those requests received from the public.

The return on an expanded research effort would logically be an increased rate of identifications, once translated into recovery operations. However, this assumes that there are sufficient Recovery Teams (RTs) and anthropologists both in the field and in the lab to work through an increased workload. For the near- to mid-term, given the number of sites already approved for excavation, it is questionable whether an increase in sites

identified would yield more identifications. For the long term, this effort would undoubtedly be necessary.

**b. Sites Approved for Recovery Missions and CIL Accession Rates**

As of March 2009, there were 247 sites (across all conflicts) that had been identified and approved for recovery missions. Based on an average of 40 JPAC recovery missions per year, if there were no other extenuating circumstances, it would take approximately six years to conduct one recovery operation at each of these approved sites. It cannot be assumed that after one recovery operation, each site would be able to be closed. Moreover, there are many factors to consider which impact how many and which sites can be done in any given year. These factors include site access, weather, high costs of some of the more challenging sites, and the number of personnel the host nation will permit. For the SEA sites, DPMO has indicated that these sites are estimated to take 10 years to complete. However, if operations in Vietnam are accelerated in line with the Vietnamese government's offer, that timeframe could be reduced. Table 8 shows the breakdown of these 247 sites by conflict.

**Table 8. Sites Approved for Recovery Operations**

<b>Conflict</b>	<b>Approved Recovery Sites</b>
Southeast Asia	186
Korea	11
World War II	48
Other	2 (WWI)
Total	247

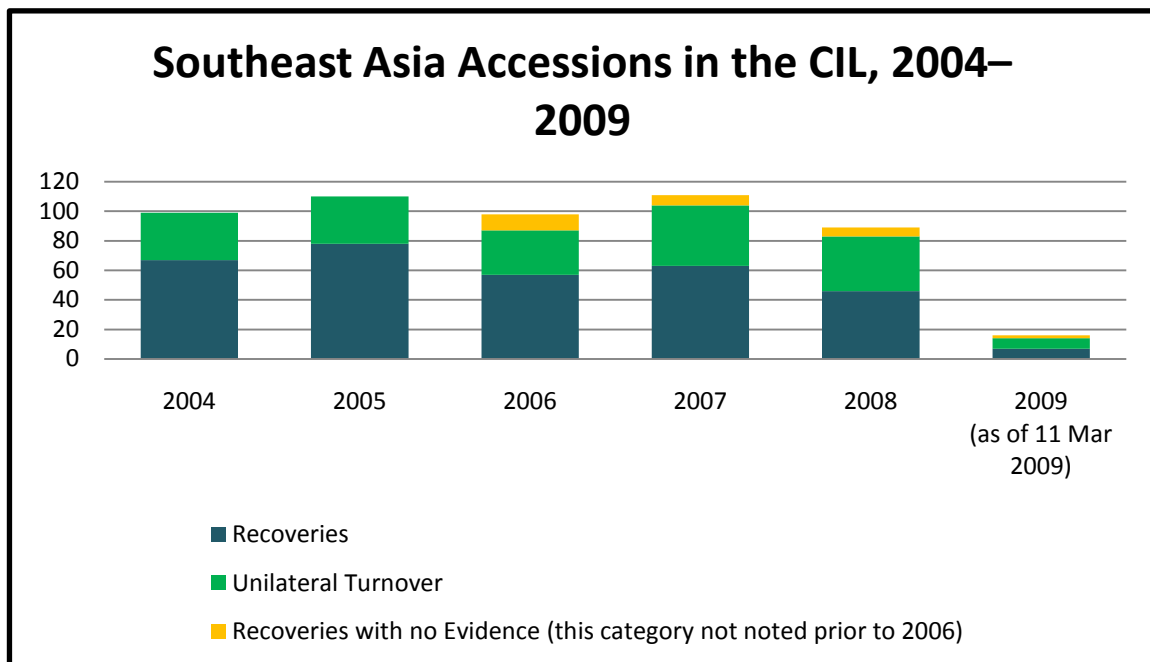
Thus, to a large degree, the workload of JPAC is known over the next decade. Beyond this timeframe, the work will transition to a focus on the identification and assessment of, and recovery operations at newly identified sites.

Currently, JPAC weighs several tactical factors when determining which sites to visit, either by an Investigative Team (IT) or an RT. For example, proximity plays a significant role in site selection. Whenever possible, JPAC tries to optimize recovery locations in order to visit as many sites as possible within one deployment. This means that sites which may not be high priority sites are still visited and even recovered if they are located near another site on the excavation list. PACOM and OSD guidance are also considerations in site selection. Both the JPAC J3 and J5 communicate with PACOM

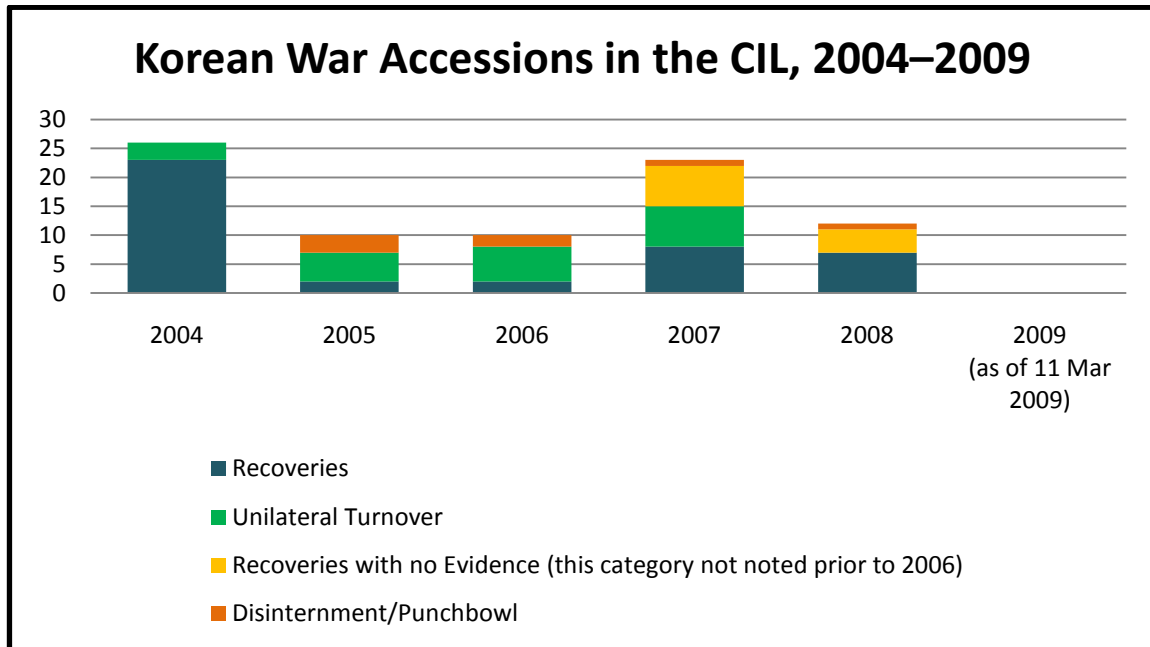


frequently to ensure harmonization of effort and resources. PACOM recognizes that the humanitarian nature of JPAC's mission contributes to its strategy of partnership and presence, and can offer a means for building relationships (which would not otherwise exist) with certain countries. For its part, OSD has also played a role in JPAC's JFA coordination, particularly with regards to entry into China and, more recently, discussion over engagement with Burma.

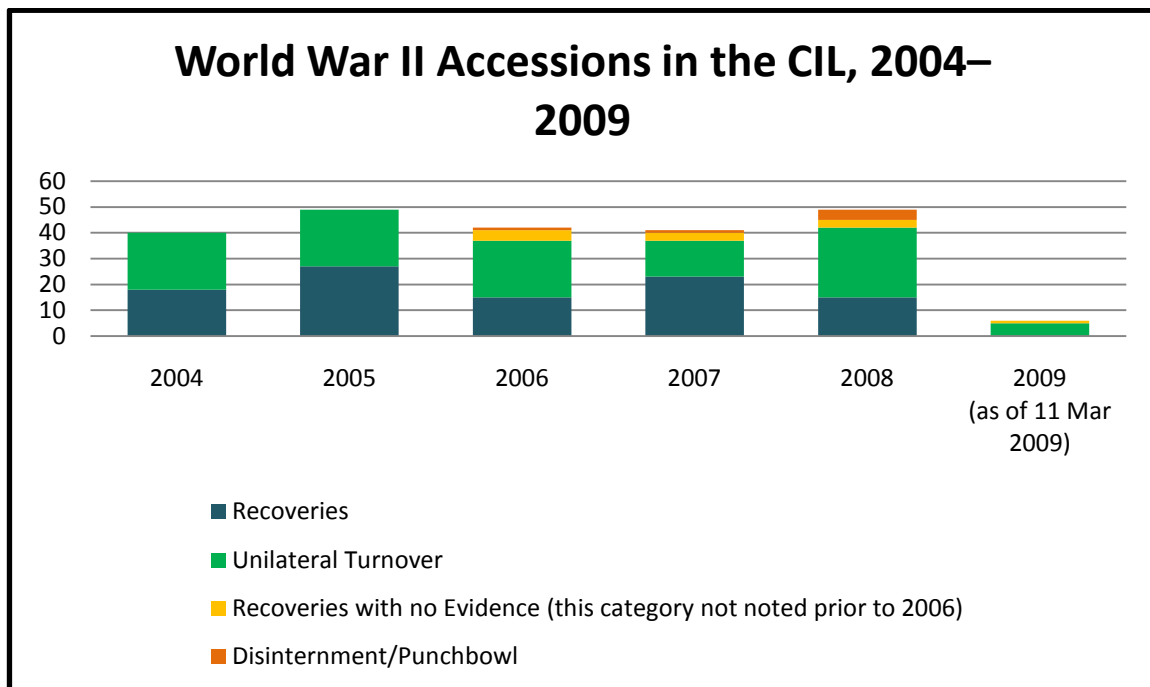
The average number of accessions coming into the CIL between 2004 and 2008 for World War II, Korea, and SEA is 163 annually. The following figures illustrate for each conflict whether the accession was as a result of JPAC field operation; whether there was such an operation but it yielded no evidence; whether it was as a result of a unilateral turnover; or whether it was as a result of an exhumation (to include remains from the Punchbowl).



**Figure 9. Southeast Asia Accessions in the CIL, 2004–March 2009**



**Figure 10. Korean War Accessions in the CIL, 2004–March 2009**



**Figure 11. WWII Accessions in the CIL, 2004–March 2009**

These figures illustrate that SEA accessions (excluding “recoveries, no evidence”) have averaged 59% of the accessions coming into the CIL for the three conflicts. At the same time, for the category of “recoveries, no evidence,” SEA also accounts for the largest amount, averaging 53% for the three years this category has existed, reflecting the lower rate of successful remains recoveries in SEA operations.

The rate of unilateral turnovers is substantial across all the conflicts. Taken as an average over 2004–2008, unilateral turnovers accounted for 38% of the accessions coming into the CIL for World War II, Korea, and SEA. While these accessions did not entail CIL (or other JPAC) staff time spent on a recovery mission, the challenges they can pose would generally make the lab work on them more complex and time-consuming.

In order to maintain a higher rate of identifications for the long term, the recovery rate will also have to keep pace at least with current levels. The complexities of recovery operations for the accounting mission underscore the importance of assembling a five-year recovery mission plan. This is a plan that JPAC is in the process of creating which could be expected to lead to more systematic deployments and, hopefully, higher recovery rates. This approach might include a more concerted and integrated effort to work through all sites in a given country within one to three years rather than the more piecemeal approach that has been pursued to date in some countries.

### **c. Identification Work**

In the future, the relative emphasis of recovery operations across conflicts will determine both the total workload for JPAC and the character of the work to be undertaken. As noted above, three important examples are exhumation of Korean War remains at the Punchbowl, WWII aircraft crash-site remains, and remains still located in North Korea. The strategy for the future of the mission will need to consider the relative emphasis across conflicts as well as the implications for the workload and character of the work in the laboratory.

## **3. The Long-Term Mission, Command Relationships, and Location of the Laboratory**

A final consideration for developing the long-term strategy for JPAC and the CIL is to address the relationship between the future mission, command relationships, and the location of the laboratory. These three considerations are intrinsically linked in that the future mission should be the primary determinant of command relationships and location.

DoD's current policy is that the CIL should remain focused on its identification activities in order to meet the commitment to the families of those missing from prior conflicts. Given this focus, it is appropriate that the CIL remains integrated within JPAC. Unification of research, recovery, and identification operations contributes to overall effectiveness, in that it encourages the involvement of scientists in every phase of the identification process. A change in mission that would broaden the charter for the CIL or otherwise increase the lab's work for other government agencies (which today is done by exception as events dictate) might create other important relationships, which could give reason for reassigning the CIL to another organization. But until that happens, the work of the laboratory will be predominately intertwined with that of JPAC.

DoD's current initiative to establish a DoD-wide forensics program represents a case-in-point illustrating a plausible alternative assignment of the CIL.<sup>45</sup> Under this initiative, DoD may create a unified DoD forensics program that would encompass the CIL, along with the criminal forensic laboratories of the military Services, and other related DoD activities. Assigning the CIL to this organization would strengthen its organizational and professional ties with sister organizations, and perhaps improve the CIL's ability to attract highly capable, senior professionals. Hence, such a redirection could make sense as part of an overall strategic realignment of the mission and sponsoring relationships.

Linked to the future mission of the laboratory is the question of whether the entire laboratory should be moved to the mainland. Table 9 outlines several considerations for evaluating the advantages and disadvantages of relocating the laboratory to the mainland.

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<sup>45</sup> Rick Tontarski, "Defense Forensic Enterprise System," Briefing to the DoD Forensics Workshop, 21 September 2007.

**Table 9. Observations on Relocation of the JPAC CIL to the Mainland**

<b>Evaluation Factor</b>	<b>Observations</b>
Total Cost	<ul style="list-style-type: none"><li>• New building space in Hawaii would be very expensive relative to leased space on the mainland.</li><li>• Personnel costs in Hawaii would be substantially higher than on the mainland.</li><li>• Travel time and expense allowances would have to be increased to support recovery operations from the mainland.</li></ul>
Recruitment and Retention of Scientists and Technicians	<ul style="list-style-type: none"><li>• The question remains as to whether the aggressive incentive program assumed in the cost calculation will be sufficient for hiring and retaining experienced scientists in Hawaii.</li></ul>
Facilities	<ul style="list-style-type: none"><li>• Because JPAC has already expended funds to expand the laboratory and renovate Building 220 on Pearl Harbor, the incremental costs of facilities would be increased by a move to the mainland.</li><li>• However, because new construction costs and maintenance costs are substantially higher in Hawaii, the cost of mainland facilities may be substantially lower than the cost of building a new laboratory facility as part of the JPAC relocation on Hickam AFB.</li></ul>
Recovery Operations Efficiency and Effectiveness	<ul style="list-style-type: none"><li>• Teamwork for recovery operations between JPAC J-2, J-3, and USPACOM is facilitated by the co-location of the laboratory in Hawaii.</li></ul>
Identification Process Efficiency and Effectiveness	<ul style="list-style-type: none"><li>• Teamwork among JPAC CIL, SCOs, and AFDIL for identification activities is facilitated by the location of the laboratory on the mainland.</li></ul>
Startup and Relocation Costs	<ul style="list-style-type: none"><li>• Startup and relocation costs would be substantial were the laboratory to be moved to the mainland. These costs include:</li><li>• Logistics costs of moving the laboratory equipment</li><li>• Relocation costs for staff</li><li>• Lost staff who do not want to relocate</li><li>• Downtime during the move</li><li>• Costs of start up and certification of a new facility</li></ul>

Given the current mission of the CIL, which is focused on the identification of the missing from prior conflicts, the current location in Hawaii is appropriate. As indicated in Table 9, it would be very costly to move the lab—in terms of the logistics costs, relocation costs, the downtime in operations during the move, the startup costs of a new facility, and the loss of staff who do not want to relocate. Consequently, very large benefits would have to accrue in order to justify such large costs. There would be some significant benefits from moving to the mainland, in terms of the ability to hire and retain the right mix of scientists and the improved ability to interact with the rest of the

identification community, particularly AFDIL and the SCOs on the collection of reference DNA and the employment of DNA typing.

Should the laboratory remain in Hawaii, the need to develop an effective human capital strategy and plan for scientific staff will be of paramount importance. JPAC and CIL leadership should jointly create a human capital strategy that is sufficient to build and sustain the necessary scientific staff, in terms of talent, experience, and maturity. This presents a difficult challenge of forging a unified view on the staffing requirements for the CIL, and the innovative and flexible use of available personnel authorities.

Continued flexibility and innovation in recruiting and retaining scientific staff will be necessary. The solution may require fairly expensive incentives for a few senior individuals. However, the numbers will be small and the cost will be relatively small in absolute terms and relative to the cost of moving the CIL to a new location on the mainland.

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## **VI. NEXT STEPS**

This report outlines three parallel lines of action for the accounting community:

- Implement the recommended improvements outlined in Chapters II and III. Foremost among these is the necessity of accelerating the collection of FRS for the Southeast Asian and Korean Wars. Another important recommendation is to develop a human capital strategy for the scientific staff in the CIL in order to ensure that a fully capable staff can be retained.
- Further develop the plans for the initiative to resolve pending Korean War cases in three to five years, if a higher identification rate is felt to be necessary beyond the changes outlined in Chapters II and III. These plans should be evaluated to ensure they yield the most cost-effective approach, determine the best location, and assess the support of DoD leadership for providing the funding needed to support such an initiative.
- Develop a long-term execution plan that would clarify missions, priorities, and hence the workload that should drive decisions on the long-term direction for the CIL.



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## **APPENDIX A: INTERVIEWEES**

### **U.S. GOVERNMENT ACCOUNTING COMMUNITY**

#### **AFME (4)**

Armed Forces Medical Examiner (AFME)  
Armed Forces DNA Identification Laboratory (AFDIL)

#### **AIR FORCE SCO (2)**

#### **ARMY SCO (6)**

#### **CIL (CURRENT STAFF) (22)**

#### **CIL / JPAC (FORMER STAFF) (5)**

#### **DPMO (6)**

Leadership  
Policy Directorate  
Plans Directorate

#### **JPAC (17)**

Commander's Staff  
Comptroller  
J1 Manpower, Personnel & Administration  
J2 Intelligence Directorate  
J3 Operations  
J5 Policy

#### **JOINT STAFF (1)**

J1 Manpower and Personnel

**LSEL (1)**

**MARINE CORPS SCO (3)**

**NAVY SCO (2)**

**PACOM (9)**

J0 Special Staff

J1 Manpower, Personnel, Administration Directorate

J4 Logistics Security Assistance Directorate

J5 Strategic Planning Policy Directorate

J8 Resources Assessment Directorate

**BENCHMARKING ORGANIZATIONS (6)**

Bode Technology

Federal Bureau of Investigation (FBI)

Argentine Forensic Anthropology Team

The International Commission on Missing Persons

U.S. Army Criminal Investigation Laboratory (USACIL)

Smithsonian Institution

**FAMILY GROUPS AND CONCERNED CITIZENS (3)**

National League of Families of American Prisoners and Missing in Southeast Asia

Korea Cold War Families of the Missing

Independent POW/MIA Advocate

## APPENDIX B: COST ASSUMPTIONS AND ESTIMATES

### Near-Term, Task-Focused Activity: Staffing and Output Assumptions

	Hawaii	Mainland
<b>Staffing</b> <ul style="list-style-type: none"> <li>• Director/Deputy</li> <li>• Senior Scientist (10+ YOS, ASCLAD – LAB Cert)</li> <li>• Staff Scientists</li> <li>• ORISE/ Tech</li> </ul>	0 2  2 1	1 2  2 1.5
<b>Facilities</b>	Building 220	5K – 7K Sq Ft. Leased 380K in improvements
<b>Recovery Operations</b> (Major focus is on IDs but one recovery op/year is assumed to maintain currency and integration with JPAC operations)	0	0
<b>IDs</b> <ul style="list-style-type: none"> <li>• Assumed productivity is 2x recent CIL average i.e. 6 vs 2.9 IDs /scientist.*</li> <li>• Assumes the following:               <ul style="list-style-type: none"> <li>• DNA in the CIL is sampled</li> <li>• FRS surge is completed on schedule</li> <li>• Sufficient space to examine comingled remains</li> <li>• Activity is focused</li> </ul> </li> </ul>	30	30

\* The average number of identifications per scientist in the CIL was calculated by dividing the total number of IDs from 2000 – 2008 (681) by the total number of anthropologists assigned for each respective year (235).  $681/235 = 2.9/\text{year}$ . Rounding up to 3/year then assuming each anthropologist's productivity will double as a result of the four factors articulated in the assumptions, the new average rate of identifications per anthropologist would be 6/year. If five additional anthropologists are hired, their total productivity would increase identifications by five to 30/year (6x5).

## Activity Costing Assumptions (\$100s)

	Hawaii	Mainland
Pay <ul style="list-style-type: none"> <li>Director/Deputy</li> <li>Senior Scientist (10+ YOS, ASCLAD – LAB Cert)</li> <li>Staff Scientists</li> <li>ORISE/ Tech</li> </ul>	150* 110*  80* 70*  * 25% COLA	120 88  64 56
Staff Indirect and Administration	60% of salary, per DoD	60% of salary, per DoD
Operations Costs	\$ 250K / year	\$250K / year
Targeted Incentives <ul style="list-style-type: none"> <li>Senior Scientist Hiring</li> <li>Scientist Retention</li> <li>Education Reimbursement</li> </ul>	25 / hire 15% bonus / year 25 / hire	
PCS	35 / hire (Senior Scientist) 10 / hire (Staff & ORISE)	15 / hire (Senior Scientist) 5 / hire (Staff & ORISE)
Recovery Ops (average allowance)		
Facility Improvements & Relocation	0 (Costs for Building 220 improvements already incurred)	380
Facilities <ul style="list-style-type: none"> <li>Lease : 5K – 7K sq ft x \$15.50 / sq ft. / yr. avg. per Northern Virginia market survey)</li> <li>Operations (\$5/ sq. ft./yr per DoD)</li> </ul>	0 (Allocates no additional lease or ops costs for the initiative.)	102.5 – 132.5K /year

Preliminary – Do Not Quote or Cite

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## Cost Calculation Spreadsheet

	Additional Director/ Deputy	Additional Senior Scientists	Additional Staff Scientists	Additional ORISE/Tech	Personnel Indirect Costs (Factor = 1.6 x salary)	Additional Recovery Ops	Operations Costs	Transition Costs (5 yr amortization)	Steady-State Costs	Cost Total (Increment for each Options)
<b>Expand Staff in Current Facilities</b>	<b>0</b>	<b>2</b>	<b>2</b>	<b>1</b>		<b>0</b>	<b>\$250,000</b>			
Salary		165,000	120,000	52,500	202,500					
Salary + Incentives		303,000	160,000	70,000						
PCS Cost		14,000	14,000	7,000						
Hiring Bonus		10,000	5,000							
Recovery Ops										
Facility Planning, Design, Approvals										
Facility Construction										
Facility Lease, Security, Ops					<b>Total Pers =</b>					
Total Increment		327,000	179,000	77,000	<b>785,500</b>	0	250,000			<b>1,035,500</b>
<b>Create Satellite Facility on the Mainland Under JPAC</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>1.5</b>		<b>0</b>	<b>\$250,000</b>			
Salary	120,000	165,000	120,000	78,750	290,250					
Salary + Incentives										
PCS Cost	7,000	6,000	6,000	4,500						
Hiring Bonus										
Recovery Ops										
Personnel Relocation								7,000		
Facility Planning, Design, Approvals, Improvements								76,250		
Facility Construction										
Facility Lease + O&M					<b>Total Pers =</b>				102,750-132,750	
Total Increment	127,000	171,000	126,000	83,250	<b>797,500</b>	0	250,000	83,250	102,750-132,750	<b>1,233,500 - 1,273,500</b>
									<b>Cost Ratio:</b>	<b>1.19-1.22</b>

## APPENDIX C: SURVEY FINDINGS

LAB	TOTAL:	24		
	<b>GENDER:</b>			
		<i>Male</i>	<b>19</b>	79%
		<i>Female</i>	<b>5</b>	21%
	<b>AGE:</b>			
		<i>20-29</i>	<b>4</b>	17%
		<i>30-39</i>	<b>9</b>	38%
		<i>40-49</i>	<b>9</b>	38%
		<i>50-59</i>	<b>1</b>	4%
		<i>60-69</i>	<b>0</b>	0%
	<b>HIGHEST LEVEL OF EDUCATION:</b>			
		<i>High School Diploma / GED</i>	<b>0</b>	0%
		<i>Some College</i>	<b>2</b>	8%
		<i>AA/ AS Degree</i>	<b>3</b>	13%
		<i>BA / BS Degree</i>	<b>0</b>	0%
		<i>Masters Degree</i>	<b>8</b>	33%
		<i>Ph.D Degree</i>	<b>7</b>	29%
		<i>Post Doctorate Certificate</i>	<b>4</b>	17%
	<b>HOW MANY YEARS HAVE YOU BEEN WORKING IN YOUR FIELD?:</b>			
		<i>1-5</i>	<b>5</b>	21%
		<i>6-10</i>	<b>4</b>	17%
		<i>11-15</i>	<b>5</b>	21%
		<i>16-20</i>	<b>5</b>	21%
		<i>21-25</i>	<b>1</b>	4%
		<i>26-30</i>	<b>3</b>	13%
		<i>31-35</i>	<b>1</b>	4%
		<i>36+</i>	<b>0</b>	0%
	<b>HOW MANY YEARS HAVE YOU BEEN AT JPAC?:</b>			
		<i>0</i>	<b>0</b>	0%
		<i>1</i>	<b>3</b>	13%
		<i>2</i>	<b>4</b>	17%
		<i>3</i>	<b>2</b>	8%
		<i>4</i>	<b>1</b>	4%
		<i>5</i>	<b>3</b>	13%
		<i>6</i>	<b>1</b>	4%
		<i>7</i>	<b>2</b>	8%
		<i>8</i>	<b>3</b>	13%
		<i>9</i>	<b>4</b>	17%
		<i>10</i>	<b>0</b>	0%
		<i>11+</i>	<b>1</b>	4%

<b>DO YOU WANT TO REMAIN AT JPAC UNTIL YOU RETIRE?:</b>			
	Yes	9	38%
	No	15	63%
<b>DO YOU WANT TO WORK AT JPAC FOR:</b>			
	5 Years or Less	9	38%
	10 Years	8	33%
	15 Years or More	7	29%
<b>WHAT ATTRACTED YOU TO COMING TO WORK FOR JPAC?</b>			
<a href="#">Click Here to View the Individual Responses</a>			
<b>WOULD YOU RECOMMEND A JOB AT JPAC TO A FRIEND?:</b>			
	Yes	18	75%
	No	6	25%
<b>WHY OR WHY NOT?</b>			
<a href="#">Click Here to View the Individual Responses</a>			
<b>WHAT IS YOUR CURRENT POSITION?:</b>			
	Military: Deploying Military	2	8%
	Military: Non-Deploying Military	1	4%
	Federal Employee / Contractor: Manager	1	4%
	Federal Employee / Contractor: Deploying Archeol/Anthro	10	42%
	Federal Employee / Contractor: Non-Deploying Archeol/Anthro	0	0%
	Federal Employee / Contractor: Other	4	17%
	ORISE: Lab tech / Non-Deploying	1	4%
	ORISE: Deploying archeol/anthro	5	21%
	ORISE: Non-Deploying archeol/anthro	0	0%

	<b>HOW MANY DAYS DO YOU SPEND DEPLOYED ON FIELD OPERATIONS ANNUALLY?:</b>			
		0	2	8%
		1-5	0	0%
		5-15	0	0%
		15-30	0	0%
		30-50	4	17%
		50-90	2	8%
		90-110	8	33%
		Over 110	8	33%
#REF!				
	<b>IF DEPLOYED, IS YOUR TIME:</b>			
		About right	10	42%
		Too Little	2	8%
		Too Much	10	42%
	<b>DID THE LOCATION OF JPAC IN HAWAII INFLUENCE YOUR INITIAL DECISION TO TAKE YOUR JOB?</b>			
		Yes	14	58%
		No	10	42%
	<b>DID THE LOCATION OF JPAC INFLUENCE YOUR LONG TERM PLANS TO REMAIN IN YOUR CURRENT JOB?</b>			
		Yes	18	75%
		No	6	25%
	<b>HAVE PERSONNEL OR QUALITY OF LIFE INITIATIVES UNDERTAKEN IN THE LAST YEAR DIRECTLY AFFECTED YOU?</b>			
		Yes	11	46%
		No	13	54%
	<b>IF YES, WHAT WERE THEY?</b>			
	<a href="#">Click Here to View the Individual Responses</a>			
	<b>IF THERE WERE RESEARCH AND DEVELOPMENT MONEY AVAILABLE, IS THERE A RESEARCH PROJECT YOU WOULD LIKE TO PURSUE THAT COULD INCREASE THE ID RATE AND IF SO, HOW QUICKLY (in the next 1-3, 3-5, 5+ years)?</b>			
	<a href="#">Click Here to View the Individual Responses</a>			
	<b>IF YOU COULD CHANGE ONE ASPECT OF YOUR JOB, CHANGE ONE PROCESS OR PURCHASE ONE ITEM TO MAKE YOUR WORK EASIER/MORE EFFICIENT, WHAT WOULD IT BE?</b>			
	<a href="#">Click Here to View the Individual Responses</a>			



<b>HOW MANY HOURS DO YOU WORK PER WEEK?</b>				
		0-9	0	0%
		10-19	0	0%
		20-29	0	0%
		30-39	0	0%
		40-49	16	67%
		50-59	7	29%
		60-69	1	4%
		70-79	0	0%
		80+	0	0%
<b>HOW MANY HOURS OF OVERTIME DO YOU WORK PER WEEK?</b>				
		0	10	42%
		1-5	7	29%
		6-10	7	29%
		11-15	0	0%
		16-20	0	0%
		20-25	0	0%
		26-30	0	0%
		31-35	0	0%
		36-40	0	0%
		41+	0	0%
<b>HOW MANY HOURS OF COMPENSATORY TIME DO YOU EARN PER YEAR?</b>				
		0	6	25%
		1-5	0	0%
		6-10	0	0%
		11-15	1	4%
		16-20	1	4%
		20-25	0	0%
		26-30	2	8%
		31-35	0	0%
		36-40	1	4%
		41+	13	54%
<b>ARE THERE ANY TASKS YOU PERFORM THAT YOU FEEL ARE NOT MISSION ESSENTIAL?</b>				
		Yes	15	63%
		No	9	38%
<b>IF YES, WHAT TASK DO YOU RECOMMEND BE DELETED?</b>				
<a href="#">Click Here to View the Individual Responses</a>				

## **APPENDIX D**

### **GLOSSARY**

AFDIL	Armed Forces DNA Identification Lab
ASD(GSA)	Assistant Secretary of Defense (Global Security Affairs)
CARIS	Centralized Accounting Repository and Information System
CCIF	Combatant Commander Initiative Fund
CIL	Central Identification Laboratory
DASD	Deputy Assistant Secretary of Defense
DoD	Department of Defense
DPMO	The Defense Prisoner of War/Missing Personnel Office
FRS	Family Reference Sample
HV	Hypervariable
IT	Investigative Team
IDA	Institute for Defense Analyses
JFA	Joint Field Activity
JPAC	Joint POW/MIA Accounting Command
LMS	Local Market Supplement
MNI	Minimum Number of Individuals
MPA	Missing Personnel Affairs
mtDNA	mitochondrial DNA
NAVFAC	Navy Facilities
NFP	No Further Pursuit
NHANES	National Health and Nutrition Examination Study
NIST	National Institute of Standards and Technology
NPRC	National Personnel Records Center
nucDNA	Nuclear DNA
O&M	Operations and Maintenance
OMB	Office of Management and Budget
ORISE	Oak Ridge Institute for Science and Education
OSD	Office of the Secretary of Defense

PACOM	Pacific Command
PCR	Polymerase Chain Reaction
POM	Program Objective Memorandum
POW	Prisoner of War
R&D	Research and Development
RT	Recovery Team
SCO	Service Casualty Office
SEA	Southeast Asia
SNP	Single Nucleotide Polymorphism
STR	Short Tandem Repeat
UFR	Unfunded Requirement
USD(P)	Under Secretary of Defense, Policy

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14. Abstract This study was commissioned by the Defense Prisoner of War/Missing Personnel Office (DPMO) to address public and Congressional concerns over the pace and scope of work by the Joint POW/MIA Accounting Command (JPAC) to identify remains, including those already recovered but not yet identified. DPMO requested an independent assessment of viable alternatives for enhancing the efficiency and effectiveness of the operations of JPAC's Central Identification Laboratory (CIL). Specifically, IDA was tasked to examine the actions needed to increase the number of identifications to 180 per year by 2014. This report (i) identifies possible improvements in efficiency and effectiveness within existing (or currently planned) resources; (ii) describes a pragmatic near-term initiative for expanding CIL identification activities by resolving a targeted set of pending cases already in the CIL accessions, and (iii) describes the relationship between the long-term priorities of the identification mission and the types and scale of capabilities that would be necessary to achieve an annual identification rate of 180 per year.					
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